Risk factors for non-communicable disease in Vietnam: estimates of prevalence, and issues in measurement

by

Bui Van Tan, MD, MPH

Submitted in fulfilment of the requirements for the degree of Doctor of Philosophy (Medical Research)

Menzies Institute for Medical Research

University of Tasmania

October 2015

The work presented in this thesis was supervised by:

Principal supervisor

Associate Professor Christopher Leigh Blizzard, PhD

Menzies Institute for Medical Research

University of Tasmania

Hobart, Australia

and Associate supervisors

Professor Mark R. Nelson, PhD

Menzies Institute for Medical Research

University of Tasmania

Hobart, Australia

Associate Professor Velandai K. Srikanth, PhD

Menzies Institute for Medical Research

University of Tasmania

Hobart, Australia

Dr Seana L. Gall, PhD

Menzies Institute for Medical Research

University of Tasmania

Hobart, Australia

Declaration of originality

This thesis contains no material which has been accepted for a degree or diploma by the University or any other institution, except by way of background information and duly acknowledged in the thesis, and to the best of my knowledge and belief no material previously published or written by another person except where due acknowledgement is made in the text of the thesis, nor does the thesis contain any material that infringes copyright.

Signed:

Date: 30 October 2015

Name: Bui Van Tan

Statement of authority access

Signed:

Date: 30 October 2015

Name: Bui Van Tan

Statement of ethical conduct

The research associated with this thesis abides by the international and Australian codes on human and animal experimentation, the guidelines by the Australian Government's Office of the Gene Technology Regulator and the rulings of the Safety, Ethics and Institutional Biosafety Committees of the University.

Signed:

Date: 30 October 2015

Name: Bui Van Tan

Abstract

Background and Aims

Non-communicable disease (NCD) is the leading cause of death worldwide. In Vietnam, there has been an increase in morbidity and mortality rates in recent decades, but data on NCD risk factors are limited. The principal aim of this thesis was to provide national estimates of the mean levels or prevalence of NCD risk factors. The secondary aim was to investigate issues in the measurement of these risk factors, and in the analysis and interpretation of data collected and reporting of results.

Methods

A population-based survey was conducted during 2009−10 using the "WHO STEPwise approach to surveillance of risk factors for NCDs" (STEPS) methodology. Participants aged 25−64 years were selected from eight provinces representing the eight ecological and geographical regions of Vietnam. Of the 22,940 eligible subjects selected by stratified multi-stage cluster sampling, 14,706 (64%) participated. National estimates of eight NCD risk factors are presented in the first of five studies, and the other four studies provide more detailed information on tobacco smoking, alcohol use, physical activity (PA) and fruit/vegetable intake.

Results

Study 1 provides national estimates of eight NCD risk factors. Notable findings were sex-differences in proportions of current smokers (men 57.7%, women 1.7%), binge drinkers (men 25.1%, women 0.6%), active people (men 52.0%, women 41.1%), and hypertension (men 18.5%, women 10.2%). Mean levels of fruit/vegetable intake (2.8 serves/day), BMI (21.1) and blood cholesterol (5.6 mmol/L), and prevalence of diabetes (2.6%), were similar for men and women. The correlations between the summary values for each province were generally plausible, but with some anomalous findings due to the characterisation of smoking and hypertension by STEPS protocols.

More detailed information on tobacco use is presented in study 2. Male ever-smokers commenced smoking at a median age of 19 years (women 20 years) and smoked a median of 10 cigarettes/day (women 6 cigarettes/day). For men, the proportion of current daily smokers peaked in the 1965−69 birth cohort and has declined in more recent cohorts. For women, the proportion of current daily smokers has declined in successive cohorts after the 1950−54 cohort.

Study 3 provides more detailed information on alcohol use. Almost 60% of men but only 4% of women consumed alcohol during the last week. Nearly 40% of men were hazardous/harmful users. Gains in model calibration and subject discrimination from information on quantities of ‘standard drinks’ were minor after the contribution from binary responses to questions on whether or not alcohol had been consumed during the reference period.

Study 4 provides more detailed information on domain-specific and overall PA. Approximately 70% met WHO recommendations for PA. Most PA was from work activity, which was higher in rural areas and varied by season. One-in-six provided unrealistically high PA values. Box-Cox transformation was the most successful method of reducing the influence of large values, but values scaled to the average Vietnamese energy intake produced the strongest correlations with pathophysiological outcomes.

More detailed information on fruit/vegetable consumption is presented in study 5. Nearly 80% reported having less than five servings of fruit/vegetables daily in a typical week. The measurements were plausibly correlated with socioeconomic factors in individual-level analyses, and with provincial characteristics in aggregate analyses.

Conclusions

This thesis provides the first nationally-representative estimates of mean levels or prevalence of NCD risk factors in Vietnam. These data suggest that efforts to limit future growth in NCDs should be targeted at reducing tobacco smoking and binge drinking by men, encouraging physical activity, and increasing consumption of fruit and vegetables. These interventions should take account of the sex-, urban-rural and regional differences in these risk factors that were identified in this thesis. The results from this research could help to strengthen the implementation Programme of Prevention and Control of Certain Non-communicable Diseases for the Period 2010–20 in Vietnam. In addition, the findings from the extensive assessment of the application of the STEPS instrument in Vietnam in respect of the measurement of behavioural risk factors, and the analysis, interpretation and reporting of the results, should be of value for other investigators using the instrument and for other users of data.

Acknowledgements

I would like to express my gratitude and thanks to my supervisors, colleagues, friends and family for their ongoing support and encouragement not only during the preparation of this thesis, but also during my PhD candidature. The research work presented in this thesis would not have been accomplished without their support.

First and foremost, I would like to express my gratitude to my principal supervisor, Associate Professor C. Leigh Blizzard. Thank you for all your constructive guidance and statistical advice in doing this work, and constant support not only for doing this thesis, but also for the whole time I am studying in Hobart. I am very impressed with your patience with my English writing skills. Thank you for tirelessly supporting my work, no matter whether it was a week day, weekend or holiday! Without your ongoing encouragement, interest, and enthusiasm, I could not have completed this thesis.

I wish to extend my great appreciation to my Associate supervisors, Professor Mark Nelson, Associate Professor Velandai Srikanth, and Dr Seana Gall. To Mark and Srikanth, thank you for your continuous support and for the valuable guidance and comments you have provided throughout my research, as well as for sharing your expertise in non-communicable diseases. To Seana, thank you for your patience and constant support, and for sharing your expertise in behavioural risk factors and analytical research skills. Again, my thesis could not have been completed without your endless encouragement and support.

Sincere thanks also to The Atlantic Philanthropies Inc., participants in the surveys, the Ministry of Health of the Socialist Republic of Vietnam, provincial health authorities who provided data collection teams, Menzies consultants who trained and supervised the data collection teams, and Menzies staff including Catrina Boon and Kate Butorac who provided support for training and supervision. Thank you for giving me an opportunity to work on this project. To Kate, thanks for helping me out during my part time job at the Menzies clinic.

I would like to express my thanks for the scholarship providers, the University of Tasmania and The Atlantic Philanthropies Inc. for helping me to achieve my goal. I would also like to thank Dr Phung Ngoc Hai, Dr Tran Hoang Mai and Dr Au Bich Thuy, Mr Le Phi Hai, and Mr Mark Bennett for their assistance and support. To Dr Thuy, Dr Hai and Dr Mai, thank you for your constructive comments on the drafts of our papers.

To my close friends and fellow PhD candidates at Menzies – Anitra Wilson, Harbeer Ahedi, Mithun Rajshekar, William Cuellar, Kira Patterson, Benny Antony, Hoang Phan, Tran Pham, Jing Tian, Prudence Tettey, Farzaneh Atashrazm, Hussain Khan and many others – thank you for your great emotional support and encouragement, especially for the friendship and for helping me at the early stage of my candidature. Also, thank you to Dr Oliver Stannus, Dr Verity Cleland, Dr Laura Laslett, Dr Karen Wills, Dr Dawn Aitken, Dr Linda Murray, and Tim Albion for making me welcome. Thanks all for creating an environment that is not only professional and productive but also fun and a great place to work and study.

To my co-authors, Dr Huynh Long Quan, Dr Luong Ngoc Khue, Dr Truong Le Van Ngoc, Dr Tran Quoc Bao, Dr Ha Thai Son, Dr Michele Callisaya, Dr Kylie Smith, and Petr Otahal, thank you for your valuable comments on our manuscripts. To Petr, thank you for your statistical support over the years – I have really appreciated your patience with me!

I would also like to thank Uncle and Aunty Mien Le, Dr Tien Ho, Oanh Nguyen, Dr Thong Hua, Dr Phuong Nguyen, Danh Tran, Trinh Nguyen, Robert Joseph, Chau Nguyen, Jane Tran, Hoang Bui, Trang Nguyen, and other workmates at the Sapa Rose restaurant for their support and encouragement. Thank you for your friendship and all the wonderful meals and good times.

I would like to express my great appreciation to A/Prof Pham Thi Tam, Vice Rector of the Can Tho University of Medicine and Pharmacy, for her approval, strong encouragement and motivation to complete my study at Menzies. I would also like to thank my colleagues at the Faculty of Public Health for sharing a lot of the work when I am absent for my study.

Lastly, my deepest love and special thank you to my wonderful family for their love, and endless support and encouragement during my candidature. First of all, my deepest love and special thanks go to my wife, Do Thi Xuan An, and my little daughter, Bui Do Quyen (Nhim), for being with me for every step of my journey. I am grateful to An for her unending support and patience during my candidature. Without her emotional and mental support, I could not have successfully accomplished my study. Nhim, I am done now! Daddy's home! I also wish to express my thanks to my family, my family in-law, and for all of those I could not mention by name for encouraging and helping me overcome difficulties, not only in my study but also in my life.

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List of Abbreviations

NCD	Non-communicable disease
CVD	Cardiovascular disease
WHO	World Health Organization
BMI	Body Mass Index
PR	Prevalence ratio
CI	Confidence interval
MET	Metabolic Equivalent Task
PA	Physical activity
IPAQ	International Physical Activity Questionnaire
GPAQ	Global Physical Activity Questionnaire
BP	Blood pressure
DBP	Diastolic blood pressure
SBP	Systolic blood pressure
SES	Socio-economic status
STEPS	STEPwise approach to surveillance of non-communicable disease

Statement of authorship

This thesis includes manuscripts submitted for publication and published papers for which Bui Van Tan is not a sole author. He took the lead in this research by cleaning, managing, conducting data analyses and interpretation, preparing the first draft of each manuscript, and revised the manuscripts. He was, however, supervised and assisted by the co-authors. The contributions similar to all manuscripts and published paper of each author are detailed below.

- Bui Van Tan contributed to the conception and design of studies reported in this thesis, conducted analyses and interpreted data, and drafted and revised the manuscripts.
- C. Leigh Blizzard contributed to the conception and design of the project, supervised data collection, contributed to the conception of the studies reported in this thesis, supervised the data analyses and interpretation, and revised the manuscripts for important intellectual content.
- Luong Ngoc Khue contributed to the conception and design of the project, and revised the manuscripts for important intellectual content.
- Truong Le Van Ngoc contributed to the conception and design of the project, and revised the manuscripts for important intellectual content.
- Tran Quoc Bao contributed to the conception and design of the project, and revised the manuscripts for important intellectual content.
- Petr Otahal supervised data collection, contributed to the conception and design of studies reported in this thesis, conducted data analyses, and revised the manuscripts for important intellectual content.
- Mark Nelson supervised data analyses and interpretation, and revised the manuscripts for important intellectual content.
- Au Bich Thuy contributed to the conception and design of the project, supervised data collection, and revised the manuscripts for important intellectual content.
- Ha Thai Son contributed to the conception and design of the project, supervised data collection, and revised the manuscripts for important intellectual content.

- Phung Ngoc Hai contributed to the conception and design of project, supervised data collection, and revised the manuscripts for important intellectual content.
- Tran Hoang Mai contributed to the conception and design of project, supervised data collection, and revised the manuscripts for important intellectual content.
- Michele Callisaya supervised data collection, contributed to the conception and design of the studies reported in this thesis, and revised the manuscripts for important intellectual content.
- Huynh Long Quan contributed to the conception and design of the study of tobacco smoking, and revised that manuscript for important intellectual content (Chapter 3 only).
- Kylie Smith contributed to the conception and design of the study of fruit and vegetable consumption, and revised that manuscript for important intellectual content (Chapter 6 only).
- Velandai Srikanth contributed to the conception and design of the studies reported in this thesis, supervised data analyses and interpretation, and revised the manuscripts for important intellectual content.
- Seana Gall contributed to the conception and design of the studies reported in this thesis, supervised data analyses and interpretation, and revised the manuscripts for important intellectual content.

All authors approved the final manuscript.

Signed:

Date: 30 October 2015

A/Professor C. Leigh Blizzard, PhD
Principal Supervisor
Menzies Institute for Medical Research
University of Tasmania

Publications

Publication directly arising from the work described in this thesis

The STEPS paper (reported in Chapter 2)

Bui Van Tan, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Petr Otahal, Seana Gall, Mark R. Nelson, Au Bich Thuy, Ha Thai Son, Phung Ngoc Hai, Tran Hoang Mai, Michele Callisaya, Velandai Srikanth. National survey of risk factors for non-communicable disease in Vietnam – prevalence estimates and an assessment of their validity. Under review for consideration of publication in *Population Health Metrics.*

The tobacco smoking paper (reported in Chapter 3)

Bui Van Tan, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Ha Thai Son, Phung Ngoc Hai, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Tran Hoang Mai, Huynh Long Quan, Michele Callisaya, Seana Gall. Declining prevalence of tobacco smoking in Vietnam. *Nicotine & Tobacco Research*. 2015; 10(7): 831-8. DOI 10.1093/ntr/ntu202.

The alcohol paper (reported in Chapter 4)

Bui Van Tan, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Ha Thai Son, Phung Ngoc Hai, Tran Hoang Mai, Michele Callisaya, Seana Gall. Alcohol consumption in Vietnam, and the use of 'standard drinks' to measure alcohol intake. *Alcohol and Alcoholism.* 2015; 1(10). DOI 10.1093/alcalc/agv082.

The physical activity paper (reported in Chapter 5)

Bui Van Tan, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Ha Thai Son, Phung Ngoc Hai, Tran Hoang Mai, Michele Callisaya, Seana Gall. Physical activity in Vietnam – estimates and measurement issues. *PloS One. (In press).* DOI: 10.1371/journal.pone.0140941

The fruit and vegetable consumption paper (reported in Chapter 6)

Bui Van Tan, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Ha Thai Son, Phung Ngoc Hai, Tran Hoang Mai, Michele Callisaya, Kylie J. Smith, Seana Gall. Fruit and vegetable intake in Vietnam, and the use of 'standard serving' sizes to measure intake. *British Journal of Nutrition (Accepted).*

***Presenting author**

Conference presentations

1. Bui Van Tan*, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Ha Thai Son, Phung Ngoc Hai, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Tran Hoang Mai, Huynh Long Quan, Michele Callisaya, Seana Gall. Declining prevalence of tobacco smoking in Vietnam. Tasmanian Health Science HDR Student Conference. University of Tasmania. Hobart Australia. July 2013. Poster presentation.

2. Bui Van Tan*, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Ha Thai Son, Phung Ngoc Hai, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Tran Hoang Mai, Huynh Long Quan, Michele Callisaya, Seana Gall. Declining prevalence of tobacco smoking in Vietnam. Sharing Excellence in Research Conference. University of Tasmania, Hobart, Australia. September 2013. Poster presentation.

3. Bui Van Tan*, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Ha Thai Son, Phung Ngoc Hai, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Tran Hoang Mai, Huynh Long Quan, Michele Callisaya, Seana Gall. Declining prevalence of tobacco smoking in Vietnam. Australian Epidemiological Association (AEA) Annual Scientific Meeting. Brisbane Australia. October 2013. Poster presentation.

4. Bui Van Tan*, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Ha Thai Son, Phung Ngoc Hai, Tran Hoang Mai, Michele Callisaya, Seana Gall. The use of

‘standard drinks’ to measure alcohol consumption in the developing world. Tasmanian Health Science HDR Student Conference. University of Tasmania. Hobart Australia. July 2014. Oral presentation.

5. Bui Van Tan*, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Ha Thai Son, Phung Ngoc Hai, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Tran Hoang Mai, Huynh Long Quan, Michele Callisaya, Seana Gall. Declining prevalence of tobacco smoking in Vietnam. World Congress of Epidemiology. Anchorage, USA. August 2014. Poster presentation.

6. Bui Van Tan*, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Petr Otahal, Seana Gall, Mark R. Nelson, Au Bich Thuy, Ha Thai Son, Phung Ngoc Hai, Tran Hoang Mai, Michele Callisaya, Velandai Srikanth. National survey of risk factors for non-communicable disease in Vietnam – prevalence estimates and an assessment of their validity. World Congress of Epidemiology. Anchorage, USA. August 2014. Poster presentation.

7. Bui Van Tan*, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Ha Thai Son, Phung Ngoc Hai, Tran Hoang Mai, Michele Callisaya, Seana Gall. The use of ‘standard drinks’ to measure alcohol consumption in the developing world. Sharing Excellence in Research Conference. University of Tasmania, Hobart September 2014. Poster presentation.

8. Bui Van Tan*, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Ha Thai Son, Phung Ngoc Hai, Tran Hoang Mai, Michele Callisaya, Seana Gall. The use of ‘standard drinks’ to measure alcohol consumption in the developing world. The Public Health Association of Australia Annual Conference. Perth, Australia. September 2014. Oral presentation.

9. Bui Van Tan*, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Ha Thai Son, Phung Ngoc Hai, Tran Hoang Mai, Michele Callisaya, Seana Gall. The use of

'standard drinks' to measure alcohol consumption in the developing world. Australian Epidemiological Association (AEA) Annual Scientific Meeting. Auckland, New Zealand. October 2014. Poster presentation.

10. Bui Van Tan*, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Petr Otahal, Seana Gall, Mark R. Nelson, Au Bich Thuy, Ha Thai Son, Phung Ngoc Hai, Tran Hoang Mai, Michele Callisaya, Velandai Srikanth. National survey of risk factors for non-communicable disease in Vietnam – prevalence estimates and an assessment of their validity. Australian Epidemiological Association (AEA) Annual Scientific Meeting. Auckland, New Zealand. October 2014. Oral presentation.

Other presentations

1. Bui Van Tan*, C. Leigh Blizzard, Mark R. Nelson, Velandai Srikanth, Seana Gall. Epidemiology of risk factors for non-communicable diseases in Vietnam. Menzies Institute for Medical Research seminar series. Hobart, Australia. April 2012. Oral presentation (first year confirmation).

2. Bui Van Tan*, C. Leigh Blizzard, Mark R. Nelson, Velandai Srikanth, Seana Gall. Methodological issues involved in the analysis of a two-stage cluster sample – National study of risk factors for non-communicable diseases in Vietnam. Menzies Institute for Medical Research – Data Presentation Club seminar series. Hobart, Australia. April 2012. Oral presentation.

3. Bui Van Tan*, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Ha Thai Son, Phung Ngoc Hai, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Tran Hoang Mai, Huynh Long Quan, Michele Callisaya, Seana Gall. Declining prevalence of tobacco smoking in Vietnam: A reconstructed birth cohort analysis of a national survey. Menzies Institute for Medical Research – Data Presentation Club seminar series. Hobart, Australia. May 2013. Oral presentation.

4. Bui Van Tan*, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Ha Thai

Son, Phung Ngoc Hai, Tran Hoang Mai, Michele Callisaya, Seana Gall. The use of 'standard drinks' to measure alcohol consumption. Menzies Institute for Medical Research – Data Presentation Club seminar series. Hobart, Australia. May 2014. Oral presentation.

5. Bui Van Tan*, C. Leigh Blizzard, Mark R. Nelson, Velandai Srikanth, Seana Gall. Lifestyle risk factors for non-communicable disease in Vietnam – prevalence, and issues in characterization of risk. Menzies Institute for Medical Research seminar series. Hobart, Australia. July 2012. Oral presentation (final year confirmation).

6. Bui Van Tan*, C. Leigh Blizzard, Luong Ngoc Khue, Truong Le Van Ngoc, Tran Quoc Bao, Petr Otahal, Velandai Srikanth, Mark R. Nelson, Au Bich Thuy, Ha Thai Son, Phung Ngoc Hai, Tran Hoang Mai, Michele Callisaya, Seana Gall. The use of 'standard drinks' to measure alcohol consumption. Menzies Institute for Medical Research – Data Presentation Club seminar series. Hobart, Australia. September 2014. Oral presentation.

Chapter 1. Introduction

1.1 Epidemiology and burden of non-communicable diseases (NCDs) in developing countries

1.1.1 What are non-communicable diseases?

Non-communicable (chronic) diseases refer to a group of conditions that are not caused by an acute infection, result in long-term health consequences and often require long-term treatment and care. The four main types of these conditions are cardiovascular diseases (stroke and myocardial infarction), cancer, chronic respiratory diseases (chronic obstructed pulmonary disease and asthma) and diabetes (1).

1.1.2 Epidemiological transition and burden of NCDs

NCDs have become the major causes of death worldwide. In 2012, nearly three quarters of NCD deaths (28 million) occurred in low- and middle- income countries (2). The number of NCD deaths has increased globally and in every region. The total annual number of NCD deaths is projected to increase to 52 million by 2030 (3). In particular, these deaths have increased significantly in the South-East Asia region (from 6.7 million in 2000 to 8.5 million in 2012) and the Western Pacific region (from 8.6 million to 10.9 million) (Figure 1.1). The rapidly growing number of deaths from NCDs in low- and middle-income countries is largely due to the negative effects of globalisation, rapid unplanned urbanisation and industrialization (1). Associated with these transitions are population-level changes in peoples' behaviour. For example, people in these countries are increasingly eating foods with higher levels of total energy, leading increasingly sedentary lives, and are being targeted by marketing of tobacco, alcohol and junk food (1, 4).

The rising burden of NCDs and their risk factors is likely to have health, social and economic consequences in low- and middle-income nations. At the household level, most NCDs are chronic and can lead to continued expenditures that trap poor households in cycles of debt and illness. For instance, in India, one in four families in which a family member has CVD has catastrophic expenditure; consequently, 10% of these families are driven into poverty (5).

Expenditure on tobacco also contributes to household poverty (6). Household costs of NCDs are likely to have a significant impact on economic development. The loss of productivity reduces a society's effective labour force, resulting in reductions in overall economic output. For every 10% rise in mortality from NCDs, the yearly economic growth is estimated to be reduced by 0.5% (7). Furthermore, because health care systems in these countries are usually designed to deal with acute communicable diseases, a growing burden of NCDs will be a major challenge in these countries into the future (8, 9).

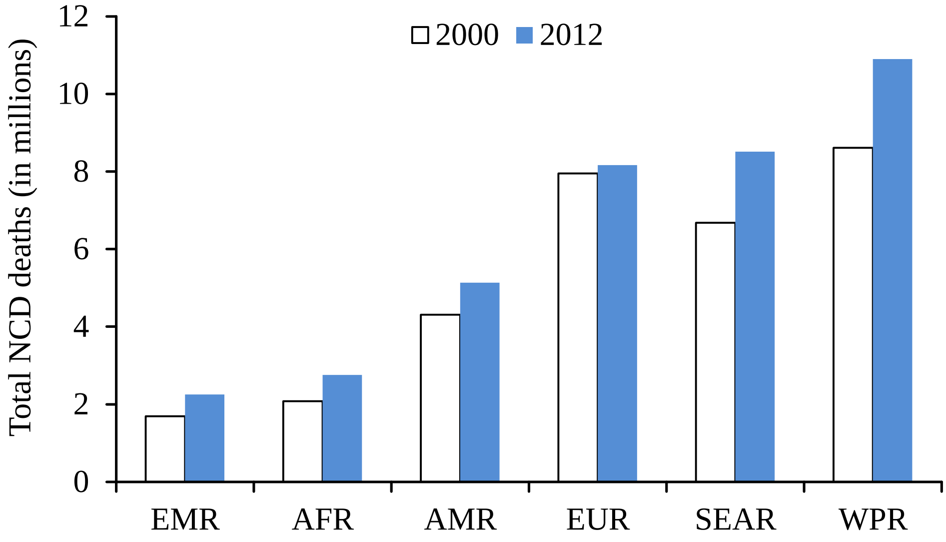


Figure 1.1. Total NCD deaths by WHO region, 2000 and 2012
(EMR–Eastern Mediterranean Region, AFR–African Region, AMR–Region of the Americas, EUR–European Region, SEAR–South-East Asia Region and WPR–Western Pacific Region). Figure produced from data compiled by WHO (2).

1.2 Modifiable risk factors in prevention of NCDs

1.2.1 Modifiable risk factors for NCDs

There are many risk factors that are associated with NCDs, with these often classified into those that are modifiable and those that are non-modifiable. Modifiable risk factors include behavioural risk factors (tobacco smoking, harmful use of alcohol, low fruit and vegetable intake, and physical inactivity), and pathophysiological risk factors (obesity, hypertension, diabetes, and hypercholesterolemia). Risk factors that are not modifiable include increasing age, male sex, race/ethnicity, and family history of NCDs (e.g. hypertension and diabetes).

1.2.2 Targeting modifiable behavioural risk factors

Recent data from major clinical trials and cohort studies have demonstrated that NCDs are largely attributed to modifiable risk factors. For example, the results of studies that pooled data from 14 clinical trials (10) and three large prospective cohorts (11) have shown that 80 to 90% of patients with significant coronary heart disease, and more than 95% of patients with fatal coronary events, had been exposed to at least one of the four common modifiable risk factors (tobacco smoking, hypertension, diabetes and hypercholesterolemia). In addition, findings from the INTERHEART study (12) – an international, standardised, case-control study with approximately 15,000 cases and 15,000 controls from 52 countries across all ethnic groups and geographic regions of the world – showed that smoking, regular alcohol consumption, physical inactivity, inadequate consumption of fruit and vegetables, psychosocial factors, obesity, hypertension, diabetes, and abnormal lipids accounted for 90% (men) and 94% (women) of risk of acute myocardial infarction worldwide. Furthermore, findings from the INTERSTROKE study (13) – an international, multicentre, case-control study – showed that these modifiable risk factors collectively accounted for nearly 90% of all types of stroke. These important results emphasise the importance of identifying and controlling these modifiable risk factors to reduce the burden of NCDs.

Also, the INTERHEART study (12) has shown that 55% of acute myocardial infarction can be attributed to just four behavioural risk factors. They are tobacco smoking, physical inactivity, poor diet and irregular alcohol use. Importantly, this was around 70% in Southeast Asia and Japan (12). Arguably, to reduce the burden of NCD, priority should be given to reducing prevalence of these behavioural risk factors. In addition, in low- and middle-income countries where NCDs affect younger individuals (14), reducing exposure to these risk factors would help to prevent disease and thereby could reduce the impact of NCD in terms of years of healthy life lost (15). Furthermore, behavioural risk factors often cluster among individuals, and success in changing one risk behaviour might increase motivation and self-confidence, or serve as a “gate way”, to change other risky behaviours (16-18). For a country in the early stage of transition, interventions to prevent the population from adopting unhealthy lifestyles associated with industrialization and modernisation are crucial (19). It is possible that developing countries could avoid the pattern of premature NCD-related deaths experienced by Western countries if appropriate interventions are put in place (20).

1.2.3 Prevention of NCDs – population-wide interventions

There is evidence suggesting that population-wide interventions have the potential to achieve larger health gains than interventions focused on individuals, and often with greater cost-effectiveness (21-26). Some effective approaches are so low in cost that country income levels need not be a major barrier to successful prevention. There is a wide range of affordable interventions that are evidence-based and can be implemented immediately to save lives and prevent disease. For example, evidence shows that tobacco control interventions are affordable in all countries. In one study, researchers modelled price increases, workplace bans, health warnings and bans on advertising for 23 countries (25). They reported that 5.5 million deaths could be averted at a cost of less than US$ 0.40 per person per year in low- and lower-middle-income countries. Similarly, promoting physical activity and healthy diet through the media is a cost-effective and highly feasible intervention (22). Community interventions that provide advice on modifications of physical activity and diet have been shown to prevent diabetes among people who have impaired glucose tolerance. The effect of participation in physical activity and improving diets is about equal to that of drug therapy (26). Established evidence for the efficacy and cost-effectiveness of interventions to reduce the harmful use of alcohol includes examples from countries such as Brazil, Mexico, China, and Vietnam (21, 24). These successful interventions emphasise the importance of population-wide intervention for controlling NCD risk factors and to reduce NCD burden. To provide the information needed for such policies and programmes, as well as to support the monitoring and evaluation of these policies and programmes, surveillance systems for monitoring NCDs and their risk factors are needed.

1.3 Surveillance of NCDs and their risk factors

One of the key steps in preventing NCDs is the development of surveillance and monitoring system for NCDs and their risk factors (1). Surveillance is the ongoing systematic collection and analysis of data to provide appropriate information regarding a country's NCD disease burden. This information may include estimates of mean levels and prevalence of NCD risk factors, and of morbidity and mortality from NCDs, coupled with the ability to track these risk factors and health outcomes over time. Surveillance of NCDs has a long history that can be traced back as far as the Framingham Heart Study in 1948. This survey has contributed to a large body of knowledge on NCD risk factors such as cigarette smoking, physical inactivity, harmful use of alcohol, unhealthy diet and high blood pressure (27). The MONICA (Multinational MONItoring of trends and determinants in CArdiovascular diseases) Project was conducted to monitor the trends in and determinants of CVD morbidity and mortality (28). This multinational descriptive study showed differences in risk factor patterns across study populations, but was conducted mainly in European countries. Only large centres that were able to follow the standardised MONICA study protocol were included in the study. These studies have focused on older adults, and less information is available for younger adults. Therefore, the results may not be generalizable to populations in developing countries where NCDs may affect younger adults (14).

Surveillance of NCDs – such as stroke, CVD and cancer – requires strict definitions and tight control of the quality of the data collection, and access to information about the cause of death (29). Owing to this, most of the surveillance has been conducted in developed countries because such surveillance is usually too technology-dependent and resource-demanding to be sustainable in developing countries. Apart from stroke surveillance (29, 30) based on a clinical definition, it is challenging to conduct NCD surveillance in developing countries. The surveillance of the risk factors for NCDs, which is less technological and resource intensive, is more feasible than disease surveillance in developing countries (31). Therefore, it may be more successful to advocate for NCD risk factor surveillance in the setting of a developing country. Surveillance of chronic disease risk factors based on standard protocols provides the baseline measurements for the evaluation of intervention programmes. The "WHO STEPwise approach to surveillance of risk factors for NCDs" (STEPS) (31) is an example of a standardised chronic disease risk factor surveillance methodology. The rational of WHO STEPS is the view that small amounts of good quality data on the major modifiable risk factors for NCDs are more valuable than large amounts of poor quality data. The STEPS approach has been developed as a simple hierarchical system that allows sufficient flexibility whilst maintaining comparability of core items over time and between countries. The STEPS approach is constructed in such a way that add-on modules can be simply built into the information package to capture, on a population basis, emerging chronic disease risk factor patterns (Figure 1.2). Similarly, surveillance of stroke (STEPS-Stroke) (30) can also be approached in this fashion. The recommended surveillance measures are categorised according to the degree of difficulty in obtaining them. Self-reported information in response to questionnaire is the first step, physical examinations requiring basic field studies is the second step, and the inclusion of biochemical measures requiring access to laboratories in the third step.

The STEPS methodology includes standardised protocols for each measurement. The first step involves obtaining questionnaire-based data on socio-demographic status, and lifestyle risk factors that have a major impact on health and are most amenable to intervention. The second step involves physical measures with height, weight, waist circumference and blood pressure as core items. The third step involves biochemical measures with fasting blood glucose and total cholesterol as core items. Once the core items of the first step are in place, and as resources permit, countries can add data items from the second and third steps. Expanded and optional data items can be added at any step to suit local needs.

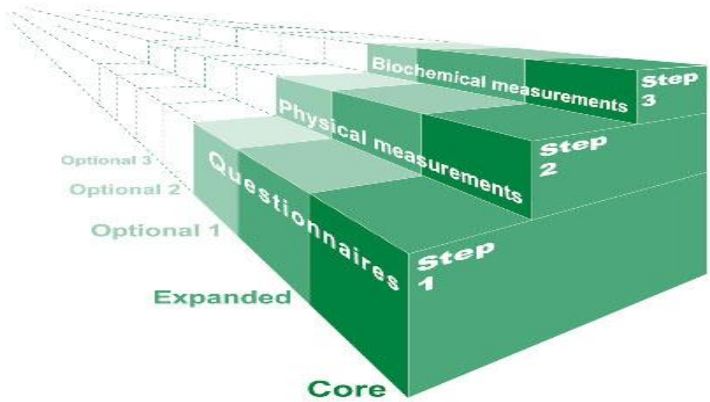


Figure 1.2. The general concept of WHO STEPwise approach

The STEPS methodology includes standardised protocols for each measurement. The first step involves obtaining questionnaire-based data on socio-demographic status, and lifestyle risk factors that have a major impact on health and are most amenable to intervention. The second step involves physical measures with height, weight, waist circumference and blood pressure as core items. The third step involves biochemical measures with fasting blood glucose and total cholesterol as core items. Once the core items of the first step are in place, and as resources permit, countries can add data items from the second and third steps. Expanded and optional data items can be added at any step to suit local needs.

1.4 NCDs in Vietnam and their risk factors

1.4.1 Epidemiological transition and burden of NCDs in Vietnam

Although there are no nationally-representative data, the emerging situation of NCDs in Vietnam is likely to be similar to other countries in the region (32). This change can be summarised as a decrease in the communicable disease (CD) mortality rate, and an increase in the NCD mortality rate (33). The trends in CD and NCD morbidity are similar to those of mortality (33). Estimates for Vietnam are based on data collected within hospitals by the Ministry of Health. The data show that the contribution of NCD to total morbidity and mortality rose steadily from 1976 to 2009 (see Figure 1.3) (33).

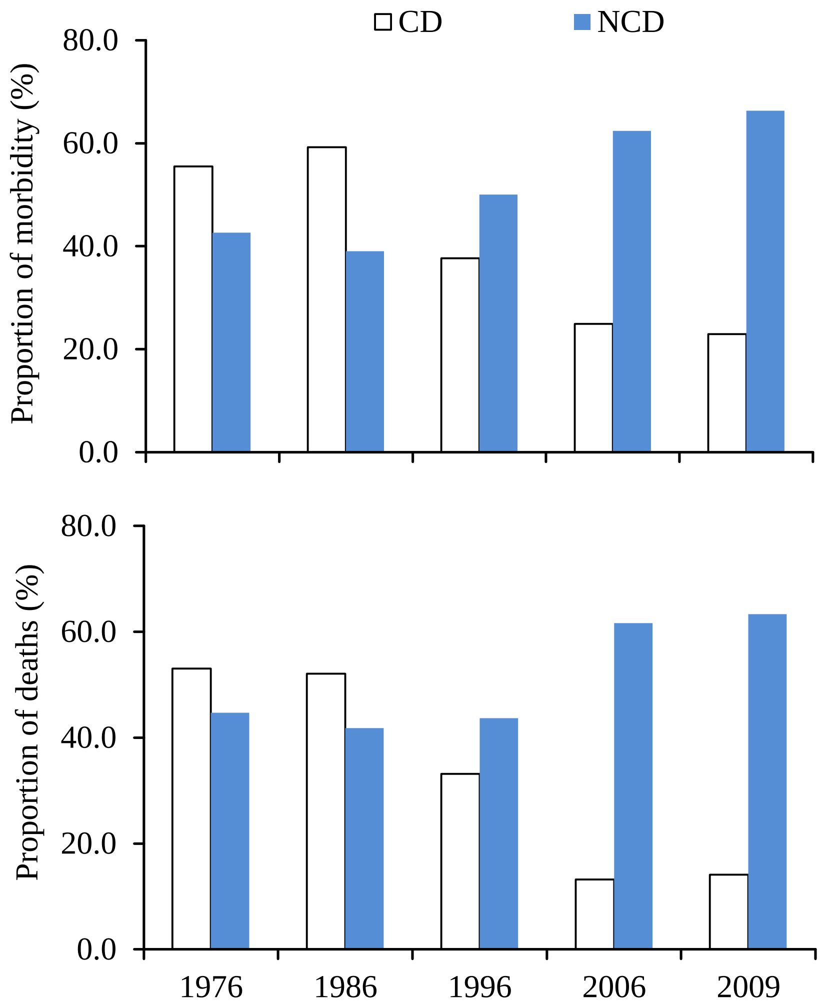


Figure 1.3. Proportions of communicable disease (CD) and non-communicable disease (NCD) morbidity (top) and mortality (bottom) in Vietnam, 1976–2009

The limited resources of the country have long been devoted to CD control (32), with little spent on controlling NCDs and their risk factors. Surveys at national level, including the Vietnam Living Standard Surveys (34, 35) and the National Nutrition Surveys (36, 37), focus heavily on CD risk factors, such as poverty, birth control, food security and food hygiene. Studies that address NCD risk factors have been limited to the urban and affluent cities of Ha Noi (38-41), Ho Chi Minh (42-46), and Can Tho (47-51). There remains a critical lack of population-based representative data on NCDs and their risk factors that are needed by policy makers and health managers, particularly data for rural areas where around 70% of the Vietnamese population live (34). Unfortunately, as a result of the limitations of the health information system as a whole, population-based data on NCD morbidity, mortality, and their risk factors at the national level are scarce. Reliable and more complete data on the extent of NCDs and related risk factors are urgently needed by those with responsibility for health planning and health decision making as well as by society in general.

1.4.2 The national NCD risk factor surveillance in Vietnam

NCD control in Vietnam and the need for information on the epidemiology of NCD in Vietnam has recently received attention. The Government's readiness to fight these diseases has been demonstrated in the Prime Minister's Decision No 35/2001/QD-TTg on Ratification of National Strategy for People's Health Care for the Period 2001–2010 (52) and No 77/2002/QD-TTg on Ratification of Programme of Prevention and Control of Certain Non-communicable Diseases for the Period 2002–2010, and the Government Resolution No 12/2000/NQ-CP on National Tobacco Control Policy 2000–2010 (53). In those documents, a number of ambitious targets for the reduction of NCD morbidity, mortality and risk factors have been set out. Conducting research, surveillance and sharing information on epidemiological aspects of NCD are considered as urgently needed actions as part of proposed solutions for achieving the targets. Data on NCD risk factors are understood as being required for the formulation of appropriate policies as well as for the implementation and evaluation of interventions to control NCDs in Vietnam.

To provide fundamental information on NCD risk factors, the first steps have been taken towards establishing a National NCD Surveillance System (NNSS) was established for collecting information that is representative of the entire population of Vietnam. In respect of surveillance of risk factors for NCDs, surveys conducted as part of NNSS applied the WHO

STEPS methodology for gathering information on NCD risk factors (31). Using standardized instruments and protocols, information was collected in eight provinces that were chosen as being representative of the eight ecological and geographical regions of Vietnam (Figure 1.4). The survey was conducted from June 2009 to May 2010.

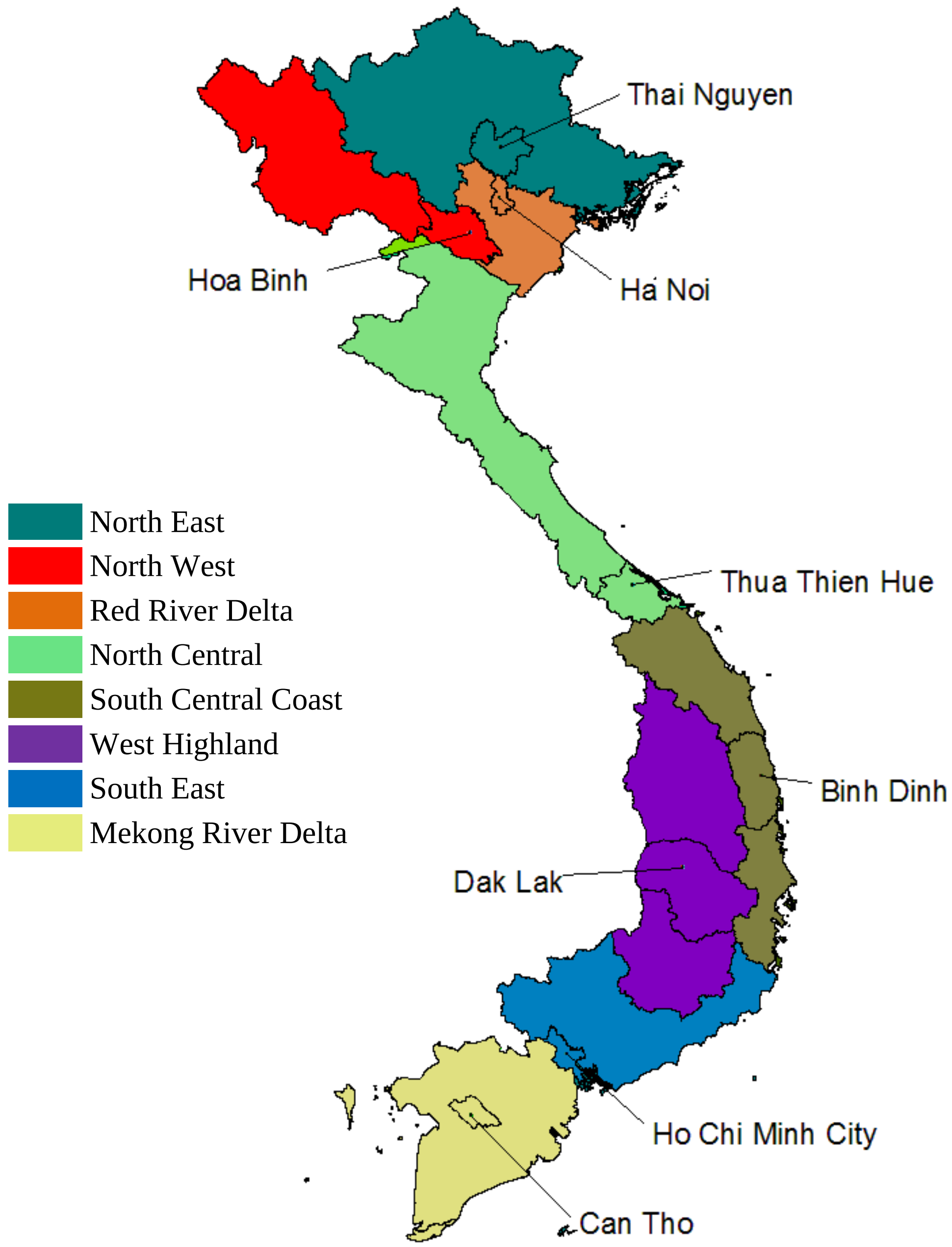


Figure 1.4. Eight provinces each represent one of the eight ecological regions of Vietnam

Eligible subjects were persons aged 25−64 years living at a residential address in each selected commune, town, or city ward of eight provinces (Thai Nguyen, Hoa Binh, Ha Noi, Hue, Binh Dinh, Dak Lak, Ho Chi Minh City and Can Tho) each representative of one of the eight geographical regions of Vietnam. They were selected by a two-stage stratified cluster sampling procedure. This sampling procedure involved selecting 20 clusters (communes, towns, and city wards) from each of eight provinces with probabilities proportional to population size from four strata defined by urban-rural location and rich-poor classification. For each selected cluster, the provincial health authority prepared a comprehensive listing of residents aged 25−64 years. From those lists, an adequate number of persons were selected in age and sex stratum to provide approximately 25 persons in each age group (25−34 years, 35−44 years, 45−54 years, 55−64 years), and 100 per cluster overall with approximately equal numbers of men and women. These persons were invited to attend a clinic on a specific date, with each clinic commencing in the early morning because overnight fasting was required. The supervisor at each site would monitor attendance by invited participants on their scheduled day of attendance. Where practical to do so, non-attendees would be visited or revisited by their local health workers and asked to attend the clinic promptly or to reschedule their appointment. Eligible subjects were provided with an information sheet about the study, and were required to sign a consent form if they agreed to participate. Of the 22,940 eligible subjects, 14,706 participated (response proportion 64.1%). Measurements were made in accordance with WHO STEPS protocols (Figure 1.5) (31). The STEPS questionnaire was modified with expanded and optional questions to suit local needs. For example, locally relevant types of work specific to the local areas were added as response options. Optional questions were added to the instrument because they were deemed locally important (in relation to salt intake, for example). The STEPS questionnaire was also used to collect information on socio-economic factors including years spent at school, the highest level of education completed, the main occupation, and the average income per adult household member in the last 12 months. The questionnaire was translated into Vietnamese and back-translated by independent translators to ensure the appropriate meaning of each item was retained. An English translation of the STEPS instrument is presented in Appendix 7A, and the original WHO STEPS instrument (version 2.1) is presented in Appendix 7B.

Step 1: Questionnaires

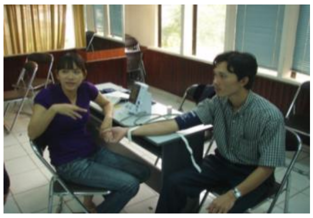
– Socio-demographic factors

– Behavioural risk factors

Step 2: Physical measurements

– Height, weight, waist circumferences

– Blood pressure



Step 3: Biochemical measurements

– Fasting blood glucose

– Fasting blood cholesterol

Figure 1.5. Fieldworkers carrying out step 1, 2, and 3

Physical measurements included weight (in bare feet without heavy clothing measured using NuWeigh B8271 digital scales), height (in bare feet without headwear measured using a Seca 214 stadiometer), waist circumference (at the narrowest point between the lower costal border and the iliac crest measured horizontally using a constant tension tape while standing), hip circumference (at the greatest posterior protuberance of the buttocks measured using a constant tension tape) with the participants standing. Blood pressure was measured at the midpoint of the right upper arm by trained staff using an Omron HEM 907 digital automatic blood pressure monitor. Two blood pressure readings were obtained for all participants after they had sat down and rested for at least 15 minutes. A third reading was taken if there was a difference between the two readings of more than 25 mmHg for systolic blood pressure (133 cases) or more than 15 mmHg for diastolic blood pressure (143 cases). If the third measure was taken, the mean of the two closest measures was used; otherwise, the mean of the two measures was used. Biomedical measures included fasting blood glucose and fasting total cholesterol measured in capillary blood using a hand-held device (Roche Diagnostics Accutrend Plus).

The protocol of this survey was approved by the Ethics Committee of the Vietnam Ministry of Health and by the Tasmanian Health and Medical Human Research Ethics Committee. Informed consent was obtained from participants. This survey was conducted by the Ministry of Health in collaboration with Menzies Institute for Medical Research, University of Tasmania, Australia, and the World Health Organization. It was funded by The Atlantic Philanthropies Inc. This population-based survey aimed to provide the prevalence of risk factors for cardiovascular diseases and diabetes among Vietnamese residents using WHO STEPS protocols and methodology (31). Therefore, estimates of the mean levels or prevalence of eight NCD risk factors are provided in thesis. More detailed information on behavioural risk factors are provided also. The candidate was not involved in the design of the national survey of NCD risk factors in Vietnam or in the fieldwork. He took the lead in cleaning the data, managing the existing data set, undertaking analyses and interpretation of the data, preparing the first draft of each manuscript, and revising the manuscripts.

1.5 Measurement of modifiable behavioural risk factors in Vietnam

Population surveys and ongoing surveillance of NCD risk factors play a key role in assessing the risk profile of the population, monitoring changes and evaluating interventions (54). To facilitate these, it is critical to have valid survey instruments. Whilst pathophysiological factors such as body composition, blood pressure, and blood chemistry indices can be measured using standard diagnostic tests developed in Western countries, lifestyle risk factors are more culturally specific. An enormous body of knowledge has been gained from research undertaken in these developed countries as or after they went through the NCD epidemic. Nevertheless, there are religious and cultural factors, and different stages of urbanisation and/or industrialization in developing countries, that may make some of the established knowledge not applicable to each specific country. The majority of the current NCD prevention guidelines and instruments are derived from research in populations of developed countries. Their applicability in the population of developing countries like Vietnam needs to be assessed.

Where possible, and within the limitations imposed by the budget available for fieldwork, an assessment of the measurements of the four major lifestyle risk factors (tobacco smoking, harmful use of alcohol, low fruit and vegetable consumption, and physical inactivity) is made and presented in this thesis. These behavioural risk factors were chosen because there is substantial evidence of their associations with NCDs (12, 13), the impact of these risk factors are predicted to increase in developing countries such as Vietnam (3), they are modifiable (55), and their measurements can be feasibly made using a self-report questionnaire. However, the standard measures used have not been rigorously tested in the context of a developing country. Undertaking such testing where practical is central to understanding the quality of the data gathered and to interpretation of the results.

1.5.1 Measurement of tobacco smoking

High-quality data on tobacco use in developing countries are limited. Data on trends in smoking prevalence (e.g. from repeated cross-sectional surveys) are required for planning and evaluating tobacco control initiatives, but these data are limited in developing countries. Nationally-representative data on smoking trends and levels of exposure over time among smokers in Vietnam were not available. Therefore, a reconstructed birth cohort analysis (56) was undertaken to provide information on changes in prevalence of smoking within birth cohorts. Potential explanations for the trends found are presented in this thesis.

1.5.2 Measurement of alcohol consumption

The most feasible method to collect data on alcohol consumption in large-scale field work is a self-report questionnaire providing information on frequency of drinking occasions and quantity of alcohol consumed on each occasion. Neither the volume nor the concentration of ethanol in each type of alcoholic beverage is taken into account directly by information solely on the frequency of alcohol consumption occasions. The quantity of alcohol consumed on each occasion is an important component of exposure conferring risk (57). Representation of quantities in terms of a ‘standard drink’ has been used in the STEPS instrument to assist respondents to report quantities consumed in terms of a common unit (31). In Vietnam, however, the methods of serving alcoholic drinks differ between urban and rural areas. For example, 70% of the Vietnamese population live in rural areas (34), and their practice is to purchase spirits that are made by small-scale local producers from rice, maize, potato or fruits

(58). The alcohol concentration of these products varies significantly from 29% to 45% (59). In addition, the alcohol is drunk from small cups of varying sizes with the result that the alcohol content of each serve varies throughout the country. The concept of 'standard drink' appears not to be well-suited in these circumstances. Therefore, the accuracy of their estimates made in terms of 'standard drinks' needed to be assessed, particularly in rural areas where home-made products are consumed in various serving sizes.

1.5.3 Measurement of physical activity

To keep public health authorities informed of changes in prevalence of physical inactivity, regular population surveillance of PA is critically needed, but measuring it accurately remains a challenge (60, 61). In population surveys, PA is typically measured by self-report questionnaires, which are low cost and relatively easy to administer and therefore remain an important tool for large scale fieldwork (60, 62). While numerous questionnaires used to measure PA are available, one widely-used questionnaire is the International Physical Activity Questionnaire (IPAQ). It has been found to have moderate reliability and fair validity in extensive testing (48, 63). The Global Physical Activity Questionnaire (GPAQ) modified from IPAQ has been used in PA surveillance in member countries as part of the WHO STEPS approach (31). GPAQ was designed as an improvement on IPAQ, particularly in respect of its amenability for cross-cultural comparisons. However, adequate guidance in the analyses, interpretation and reporting of information collected has not been provided to GPAQ users. The use of GPAQ in developing countries (e.g. Vietnam) could be influenced by non-familiarity with the Western concepts of intensity of effort, levels of literacy, and unstable work patterns conditioned on seasonal cycles in rural areas (48). In addition, there has been more limited testing of GPAQ than of IPAQ, and more is required. Issues arising in the use of GPAQ are investigated, and the findings are presented in this thesis.

1.5.4 Measurement of fruit and vegetable intake

Dietary records, 24-hour dietary recall, food frequency questionnaires (FFQs) and dietary history (64, 65) are among the methods used to assess food consumption, but use of these instruments can be time consuming and unwarranted in situations that do not require assessment of the total diet. Many brief dietary instruments for assessment of specific dietary components, such as fruit and vegetables, have been developed for use in population surveillance to monitor national and regional trends in consumption over time, and to evaluate interventions intended to modify intake for the primary prevention of chronic diseases (64, 65). These instruments can range from a single overall question to several related questions. For instance, two simple questions on fruit and vegetable consumption were used in the World Health Survey (66). Four simple questions on fruit and vegetable intake have been included in the STEPS questionnaire to collect information on the number of standard servings of fruit and vegetables per day in a typical week (31). A 'standard serving' size has been used to standardise measurement because validation studies of brief instruments in the United States suggested that the actual fruit and vegetable intake was underestimated without portion size adjustments (67-69). The STEPS questionnaire has been used to collect fruit and vegetable data in studies conducted in Vietnam (51, 70) and in other developing countries (70, 71), but the validity of data collected has not been tested. In this thesis, an assessment is made of whether intake reported in 'standard serving' sizes in response to these four simple questions by a sample of the Vietnamese population has evidence of construct validity.

1.6 Aims

The principal aim of this thesis was to provide national estimates of mean levels or prevalence of NCD risk factors in Vietnam. The second aim was to investigate issues in the measurement of these risk factors, and in the analysis and interpretation of data collected and reporting of results.

The thesis includes reports of five main research studies presented in seven chapters

Chapter 1: Introduction

> This chapter gives the context for the research presented in this thesis. It describes the epidemiology and burden of NCDs in developing countries in general and specifically in Vietnam, outlines the case for capturing data on modifiable risk factors and the need to evaluate the measurements made of these risk factors, provides a brief overview of WHO STEPS methodology, describes the sampling methodology used in a national survey of NCD risk factors, and details the aims and structure of the thesis.

Chapter 2: National survey of risk factors for non-communicable disease risk factors in Vietnam – prevalence estimates and their assessment validity.

This chapter provides national estimates of eight risk factors for NCDs in Vietnam, and investigates whether the summary estimates allow reliable inferences to be drawn regarding regional differences in risk factors and associations between them. At the time of submission this thesis, the contents of this chapter were under review for consideration of publication in *Population Health Metrics.*

Chapter 3: Declining prevalence of tobacco smoking in Vietnam.

This chapter provides more detailed information on tobacco use in Vietnam, investigates the trend in smoking prevalence over time for each birth cohort, and explores possible explanations for the trend found. The contents of this chapter have been published on *Nicotine and Tobacco Research (72).*

Chapter 4: Alcohol consumption in Vietnam, and the use of 'standard drinks' to measure alcohol intake.

This chapter provides more detailed information on alcohol use in Vietnam and investigates the validity of the 'standard drink' serving size concept used to measure alcohol intake in respect of prediction of blood pressure. The contents of this chapter have been published on *Alcohol Alcoholism (73).*

Chapter 5: Physical activity in Vietnam – estimates and measurement issues.

This chapter provides more detailed information on physical activity in Vietnam and investigates several measurement issues that arose. The contents of this chapter have been published on *PloS One (74)*.

Chapter 6: Fruit and vegetable consumption in Vietnam, and the use of 'standard serving' size to measure intake.

This chapter provides more detailed information on fruit and vegetable intake in Vietnam and examines the construct validity of intake reported in standard serving sizes. The contents of this chapter have been conditionally accepted for publication in *British Journal of Nutrition.*

Chapter 7: Summary

This chapter draws together the major findings and conclusions, summaries the collective contribution of the thesis, and presents recommendations for future research.

1.7 Postscript

The next chapter will present the results regarding national estimates of mean levels or prevalence of eight NCD risk factors in Vietnam and an assessment of the validity of these summary estimates for regional comparisons.

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Chapter 2. National survey of risk factors for non-communicable disease in Vietnam – prevalence estimates and an assessment of their validity

2.1 Preface

There are no nationally-representative population-based data on risk factors in Vietnam, and in an attempt to provide fundamental information on these risk factors, a National NCD Surveillance System was established for collecting information that is representative of the entire population of Vietnam. Taking advantage of the data collected from this system, this chapter provides regional and national estimates of eight risk factors for in Vietnam and reports the results of an investigation of whether the summary estimates allow reliable inferences to be drawn regarding regional differences in risk factors. The contents of this chapter are under review for consideration of publication in *Population Health Metrics*.

2.2 Introduction

Non-communicable diseases (NCDs) are a leading cause of death worldwide (1). In Vietnam, there has been a 30% increase in NCD morbidity and mortality between 1976 and 2009 (2). This increase may be due, in part, to improved reporting, but ageing of the population and increased exposure to NCD risk factors in a country undergoing rapid urbanisation/industrialization is also likely to be a contributing factor. The NCD risk factors include tobacco smoking, harmful use of alcohol, more sedentary forms of work and leisure, and consumption of energy dense food (1).

Information on the prevalence of NCD risk factors in Vietnam is limited to the urban and affluent cities of Ha Noi (3, 4), Ho Chi Minh City (HCMC) (5-7), and Can Tho (8-12). Although previous studies (13, 14) collected information across Vietnam, regional comparisons were not presented, different sampling strategies were used, and data for those analyses were collected at various time points (2001–2009). In addition, populations in different ecological regions are likely to have different risk profiles due to variation in numerous socio-demographic factors and lifestyle or pathophysiological factors such as overweight/obesity (15). Furthermore, about 70% of the Vietnamese people live in rural areas (16), with information on risk factors unavailable for this sector of the population.

The first aim of this study was to provide summary estimates of the prevalence of NCD risk factors at provincial and national levels. These findings will guide the development of public health policy for NCDs in Vietnam. Because the summary estimates are likely to be used to compare risk factor levels between provinces and to derive inferences about relationships between provincial levels of risk factors, our second aim was to investigate the validity of the summary estimates when used for these purposes. The findings have bearing on the use and value of data collections such as the WHO Global InfoBase, the data warehouse of information on chronic diseases and risk factors for WHO member states. One purpose of the InfoBase is to allow users to compare levels of risk factors across countries. The WHO STEPS methodology (17) is specifically designed to provide summary data that are reliable for cross-cultural comparisons (18-20), but the validity of the summary measurements for this purpose has not been subjected to rigorous examination.

2.3 Materials and Methods

2.3.1 Study participants and sampling

This population-based survey was conducted among 25 to 64-year-old residents of eight provinces in Vietnam during 2009/10. The provinces were Thai Nguyen, Hoa Binh, Ha Noi, Thua Thien Hue (Hue), Binh Dinh, Dak Lak, HCMC, and Can Tho. Each represents one of the eight ecological and geographical regions of Vietnam. Eligible subjects were selected by stratified two-stage cluster sampling. Of the 22,940 eligible subjects selected for participation, 14,706 (64.1%) participated in this survey. Written informed consent was obtained from participants. The study was approved by the Ethics Committee of Vietnam Ministry of Health and the Tasmanian Health and Medical Human Research Ethics Committee. Details of this survey have been reported elsewhere (21).

2.3.2 Measurements

Socio-demographic information on residential status (urban and rural), ethnicity (the Kinh majority group, and non-Kinh minority groups including Khmer, Tay, Ede, and Chinese), monthly household income per adult household member, years spent at school, and four behavioural factors (tobacco smoking, alcohol, fruit/vegetable consumption, and physical activity) were collected using the STEPS questionnaire (17). Pathophysiological measurements including weight, height, waist circumference, hip circumference, systolic blood pressure (SBP), diastolic blood pressure (DBP), fasting blood glucose, and fasting total cholesterol were made using the standardised procedures of the STEPS protocols (17). Data collectors were trained and co-supervised by the Menzies Institute for Medical Research, Tasmania, Australia. The questionnaire was adapted for local use and translated and back-translated. Pilot studies were conducted to test survey instruments and procedures.

2.3.3 Data analysis

Data were entered and coded in accordance with STEPS protocols (17). Provincial and national means and proportions were calculated using complex survey methods with sampling weights calculated in accord with the sampling design. Principal component analysis was used to guide the selection of the most comprehensive measure of each risk factor from all measures of it specified by STEPS protocols. An indicator that loaded most heavily upon first principal component, and produced the greatest correlation with relevant and more proximal variables, was selected. Those selected were the proportion of current smokers, binge drinkers (males ≥ five standard drinks, females ≥ four standard drinks in any day last week), respondents with at least 3000 metabolic equivalent of task (MET) – weighted minutes of physical activity per week, raised blood pressure (SBP ≥140 mmHg and/or SBP ≥90 mmHg), raised blood glucose (blood glucose values >6.1 mmol/L or taking medications for diabetes) (17), mean body mass index (BMI, kg/m^2), number of servings of fruit and vegetables per day, and total cholesterol (mmol/L). Non-missing data were re-weighted to account for missing data (22), and Box-Cox transformations were applied to continuous data (e.g. right-skewed physical activity data). Because a constant needed to be added to data with zero values, and the choice of its values is arbitrary, the constant was selected to make the summary estimate for this design (the mean of cluster means) as close as possible to the median for this design (the median of cluster medians). Pearson correlation coefficients were used to summarise the associations between survey-weighted provincial means of the socio-demographic, behavioural and pathophysiological factors stratified by sex.

2.4 Results

Summary information on the response proportions is presented in Table 2.1. The overall response proportion was 64.1% (14,706/22,940). The response proportions generally increased with age, were higher for women than men, and lowest in the two largest cities of Ha Noi and HCMC.

Table 2.1. Response proportions in the national survey of risk factors for NCDs in Vietnam, by age groups and provinces

	Men	Women	Total
	% (n/N)	% (n/N)	% (n/N)
Age groups			
25-34 years	42.0 (1423/3388)	57.6 (1745/3030)	49.4 (3168/6418)
35-44 years	59.1 (1666/2819)	73.1 (1925/2632)	65.9 (3591/5450)
45-54 years	63.4 (1791/2823)	83.8 (2146/2561)	73.1 (3937/5384)
55-64 years	66.6 (1924/2887)	74.5 (2086/2801)	70.5 (4010/5688)
Provinces			
Thai Nguyen	77.6 (963/1241)	91.6 (1087/1187)	84.4 (2050/2428)
Hoa Binh	66.4 (887/1335)	81.3 (1015/1248)	73.6 (1902/2583)
Ha Noi	45.4 (737/1624)	59.3 (906/1528)	52.1 (1643/3152)
Hue	60.4 (853/1412)	83.0 (1013/1220)	70.9 (1866/2632)
Binh Dinh	70.5 (885/1256)	90.0 (1026/1140)	79.8 (1911/2395)
Dak Lak	55.3 (872/1578)	63.0 (937/1487)	59.0 (1809/3064)
HCMC	40.1 (840/2095)	49.4 (971/1967)	44.6 (1811/4063)
Can Tho	55.8 (767/1375)	75.9 (947/1248)	65.3 (1714/2623)
Total	57.1 (6804/11,916)	71.7 (7902/11,024)	64.1 (14,706/22,940)

The summary estimates of socio-demographic, behavioural and pathophysiological characteristics are presented in Table 2.2. The proportions of urban population were highest in the provinces of HCMC, Can Tho, and Ha Noi where the proportions of physically active people were lowest, and mean BMI was highest. As expected, the proportions of non-Kinh ethnicity were highest in Hoa Binh, Dak Lak, and Thai Nguyen. Mean years of schooling and monthly income were highest in the two largest cities (Ha Noi and HCMC). The proportions of current smokers where highest in the male populations of the central provinces of Binh Dinh and Hue, and high also in Can Tho, where the proportions of binge drinkers also tended to be high. Mean fruit and vegetable consumption was generally highest in the northern provinces of Thai Nguyen, Hoa Binh and Ha Noi. The proportions with elevated glucose were generally higher in the southern-most provinces (Dak Lak, HCMC, and Can Tho), and mean cholesterol were markedly higher in HCMC and Can Tho. The proportions with raised blood pressure were low in the three principal cities (Ha Noi, HCMC, and Can Tho), and high in the mountainous province of Dak Lak. The most notable sex differences were greater mean years of schooling and levels of physical activity and higher prevalence of tobacco smoking, binge drinking and raised blood pressure among men. Despite their lower physical activity, the mean BMI of women was similar to that of men.

Correlations between the summary values are shown in Table 2.3. The urban population proportions co-varied inversely with the provincial proportions of active people (r=–0.89, men and women combined) and positively with provincial mean BMI (r=0.82, men and women combined), provincial mean cholesterol and the provincial proportions with elevated glucose. There were generally weaker associations of physical activity, BMI, cholesterol (men) and elevated glucose (men) with provincial mean years of schooling and mean household income, each of which co-varied positively with the urban proportions. In addition, years of schooling and household income were inversely related to the proportions of current smokers and binge drinkers (men). The provincial proportions of minority ethnicity were positively correlated with proportions of active people and negatively with mean levels of BMI, and positively with fruit/vegetable intake (women). Provincial mean BMI was inversely correlated with the proportions of persons reporting high physical activity (r=–0.80, men and women combined) and positively correlated with proportions with elevated glucose and mean cholesterol, which co-varied positively.

The provincial-level associations were generally larger than the corresponding strength of that association in individual-level data. Some that were disproportionately larger have been highlighted in the table (see ‘m’ symbol). Several of these involved either the proportions of current smokers or those with raised blood pressure. In addition, there were some associations of opposite sign in individual-level data (see ‘n’ symbol). Most of these were associations with raised blood pressure. As examples, the proportions with raised blood pressure were positively associated with proportions of active persons and negatively associated with mean levels of BMI (and with mean waist circumference and waist-to-hip ratios, data not shown).

Table 2.2. Characteristics of participants from the 8 representative provinces of Vietnam, by sex

	Thai Nguyen	Hoa Binh	Ha Noi	Hue	Binh Dinh	Dak Lak	HCMC	Can Tho	Total
	Mean95%CI	Mean95%CI	Mean95%CI	Mean 95%CI	Mean95%CI	Mean95%CI	Mean95%CI	Mean95%CI	Mean95%CI
Men									
Urban population [a] (%)	22.2 ±0.00	11.9 ±0.00	42.9 ±0.00	33.6 ±0.00	26.0 ±0.00	21.6 ±0.00	83.1 ±0.00	66.3 ±0.00	29.8 ±0.00
Minority ethnicity [b] (%)	14.4 ±5.70	74.8 ±3.20	0.29 ±0.34	0.03 ±0.07	0.10 ±0.20	20.4 ±4.86	5.20 ±3.70	1.62 ±1.24	5.84 ±0.87
Years at school [c]	8.69 ±0.31	7.56 ±0.26	10.2 ±0.51	8.00 ±0.46	8.10 ±0.33	8.34 ±0.48	10.0 ±0.45	8.00 ±0.65	8.26 ±0.20
Household income [d]	52.6 ±4.26	21.6 ±4.78	89.2 ±10.9	41.6 ±3.32	50.1 ±2.96	45.6 ±7.03	91.0 ±10.9	44.7 ±4.40	53.2 ±2.22
Current smoker [e] (%)	55.5 ±4.23	54.4 ±11.8	52.5 ±4.12	63.4 ±3.85	64.8 ±3.37	45.0 ±5.82	54.2 ±4.60	58.3 ±5.46	57.7 ±1.83
Alcohol intake [f]	17.3 ±4.35	20.5 ±8.25	16.6 ±3.24	34.0 ±4.28	28.1 ±3.69	29.4 ±4.64	22.3 ±4.83	30.2 ±4.75	25.1 ±1.68
Fruit/vegetable serves [g]	3.48 ±0.21	2.80 ±0.32	3.41 ±0.18	2.46 ±0.18	2.46 ±0.11	2.27 ±0.18	2.58 ±0.21	2.45 ±0.20	2.74 ±0.08
Physical activity [h] (%)	87.9 ±3.22	83.5 ±7.02	38.4 ±5.97	47.3 ±4.32	73.2 ±2.32	80.0 ±3.13	28.7 ±4.63	37.2 ±4.71	52.0 ±2.26
BMI [i]	20.4 ±0.21	20.7 ±0.46	21.8 ±0.29	20.4 ±0.21	20.6 ±0.20	21.0 ±0.23	22.1 ±0.30	21.2 ±0.33	21.1 ±0.11
Raised BP [j] (%)	20.1 ±3.33	20.2 ±2.74	15.7 ±3.01	16.2 ±3.09	21.5 ±3.27	25.5 ±3.77	17.3 ±3.10	17.0 ±3.11	18.5 ±1.29
Elevated glucose [k] (%)	1.75 ±0.97	2.73 ±1.87	2.92 ±2.28	1.50 ±0.76	1.41 ±0.88	3.33 ±2.05	3.15 ±1.42	3.89 ±1.78	2.63 ±0.72
Cholesterol [l]	4.26 ±0.04	4.46 ±0.07	4.64 ±0.06	4.47 ±0.06	4.52 ±0.05	4.51 ±0.09	4.73 ±0.07	4.80 ±0.09	4.58 ±0.03
Women									
Urban population [a] (%)	22.7 ±0.00	12.7 ±0.00	43.7 ±0.00	34.3 ±0.00	26.1 ±0.00	22.0 ±0.00	84.1 ±0.00	67.7 ±0.00	30.8 ±0.00
Minority ethnicity [b] (%)	12.3 ±4.39	74.7 ±6.65	0.94 ±0.88	0.10 ±0.14	0.26 ±0.35	18.2 ±5.55	3.59 ±2.61	2.80 ±1.80	5.41 ±0.74
Years at school [c]	8.17 ±0.34	7.00 ±0.33	9.50 ±0.41	5.50 ±0.43	6.42 ±0.20	7.00 ±0.56	9.00 ±0.47	6.00 ±0.54	7.00 ±0.18
Household income [d]	51.5 ±4.70	20.4 ±3.72	80.2 ±6.59	40.0 ±2.73	46.4 ±2.79	45.0 ±6.05	96.0 ±10.4	45.5 ±3.18	52.9 ±2.42
Current smoker [e] (%)	1.09 ±0.86	8.04 ±5.96	0.56 ±0.45	4.90 ±1.34	0.60 ±0.53	1.37 ±1.01	2.12 ±0.93	1.12 ±0.60	1.73 ±0.32
Alcohol intake [f]	1.22 ±0.89	1.48 ±2.09	0.35 ±0.51	0.44 ±0.39	0.34 ±0.41	0.10 ±0.10	1.38 ±0.84	0.88 ±1.21	0.63 ±0.24
Fruit/vegetable serves [g]	3.18 ±0.14	3.37 ±0.57	3.58 ±0.20	2.65 ±0.18	2.34 ±0.09	2.27 ±0.22	3.05 ±0.17	2.36 ±0.15	2.80 ±0.07
Physical activity [h] (%)	83.1 ±4.12	78.0 ±6.10	35.6 ±4.36	39.6 ±3.88	63.8 ±3.59	70.3 ±5.39	13.2 ±2.32	25.6 ±3.65	41.1 ±1.48
BMI [i]	20.5 ±0.27	20.2 ±0.12	21.6 ±0.24	20.9 ±0.23	20.8 ±0.21	20.6 ±0.31	21.5 ±0.23	21.9 ±0.24	21.2 ±0.10
Raised BP [j] (%)	9.05 ±2.43	11.8 ±3.28	7.69 ±1.66	9.93 ±1.88	10.4 ±1.91	15.7 ±3.64	9.09 ±1.82	13.3 ±2.19	10.2 ±0.85
Elevated glucose [k] (%)	0.84 ±0.52	3.48 ±3.47	1.84 ±0.90	1.95 ±0.84	2.58 ±1.01	3.10 ±1.47	3.28 ±1.27	4.55 ±1.54	2.58 ±0.47
Cholesterol [l]	4.17 ±0.04	4.39 ±0.05	4.61 ±0.07	4.62 ±0.06	4.76 ±0.05	4.54 ±0.07	4.85 ±0.06	4.90 ±0.08	4.66 ±0.03

a. Proportion of urban population.

b. Proportion of non-Kinh minority ethnic group.

c. Mean years of schooling.

d. Mean household income per adult person per month (USD).

e. Proportion of current smokers.

f. Proportion with binge drinking (≥4 standard drinks for females, and ≥5 standard drinks for males, on any day last week).

g. Mean daily servings of fruit and vegetables.

h. Proportion with high levels of physical activity (≥3000 MET-minutes per week).

i. Mean BMI (kg/m^2).

j. Proportion with raised BP (systolic pressure ≥140 mmHg and/or diastolic pressure ≥90 mmHg).

k. Proportion with fasting blood glucose values >6.1 mmol/L or taking medications for diabetes.

l. Mean fasting total cholesterol values (mmol/L).

Table 2.3. Correlation coefficients between provincial levels of demographic, behavioural and pathophysiological factors, by sex

Men \ Women	Urban pop [a]	Minority ethnicity[b]	Years at school [c]	H'hold income [d]	Current smokers [e]	Alcohol intake [f]	Fruit/veg serves [g]	Physical activity [h]	BMI [i]	Raised BP [j]	Elevated glucose [k]	Choles–terol [l]
Urban population [a] (%)		–0.5[m]	0.27	0.73	–0.34	0.23	–0.04	–0.92	0.86	–0.20	0.41	0.75
Minority ethnicity [b] (%)	–0.52		–0.06	–0.58	0.79[m]	0.50[m]	0.35	0.55	–0.62	0.28	0.24	–0.49
Years at school [c]	0.56[m]	–0.44		0.76	–0.31	0.25	0.72	–0.16	0.21	–0.55	–0.33	–0.16
Household income [d]	0.65	–0.59[m]	0.98		–0.56[m]	0.03	0.30	–0.66	0.62	–0.53[m]	–0.14	0.39
Current smoker [e] (%)	0.05	–0.32	–0.32	–0.18		0.45	0.29	0.23	–0.50[m]	0.09	0.18	–0.29
Alcohol intake [f]	0.07	–0.29	–0.55[m]	–0.41	0.36		0.49	0.00	–0.10	–0.24	0.15	–0.22
Fruit/vegetable serves [g]	–0.16	0.06	0.46	0.34	–0.13	–0.87[m]		0.03	–0.06	–0.68	–0.40	–0.45
Physical activity [h] (%)	–0.88	0.57	–0.56	–0.64	–0.16[n]	–0.14	0.12		–0.89	0.25[n]	–0.38	–0.82
BMI [i]	0.78	–0.25	0.82	0.82	–0.39	–0.32	0.07	–0.74		–0.18[n]	0.38	0.77
Raised BP [j] (%)	–0.57[m]	0.35	–0.39	–0.42	–0.43	0.13	–0.33	0.77[n]	–0.39[n]		0.61	0.10
Elevated glucose [k] (%)	0.50[m]	0.12	0.22	0.19	–0.63[m]	–0.05	–0.19	–0.39	0.65	–0.02		0.65
Cholesterol [l]	0.82	–0.33	0.33	0.43	–0.03	0.22	–0.39	–0.82	0.76	–0.41[n]	0.71	

a. Proportion of urban population.
b. Proportion of non-Kinh minority ethnic group.
c. Mean years of schooling.
d. Mean household income per adult person per month (USD).
e. Proportion of current smokers.
f. Proportion with binge drinking (≥4 standard drinks for females, and ≥5 standard drinks for males, on any day last week).
g. Mean daily servings of fruit and vegetables.
h. Proportion with high levels of physical activity (≥3000 MET-minutes per week).
i. Mean BMI (kg/m^2).
j. Proportion with raised BP (systolic pressure ≥140 mmHg and/or diastolic pressure ≥90 mmHg).
k. Proportion with fasting blood glucose values >6.1 mmol/L or taking medications for diabetes.
l. Mean fasting total cholesterol values (mmol/L).
m. Weaker individual–level correlation [absolute($r_{province}$) ≥0.5 but absolute($r_{individual}$) <0.05].
n. Individual–level correlation of opposite sign ($r_{province}$ >0.10 and $r_{individual}$ >–0.10 or $r_{province}$ >–0.10 and $r_{individual}$ >0.10).

This placed suspicion on its definition in STEPS protocols as SBP ≥140 mmHg and/or DBP ≥90 mmHg. This definition does not account for blood pressure treated by antihypertensive medication or other means. As shown in Table 2.4, the proportions of people taking prescribed medication for raised blood pressure, and the proportions of respondents who reported having been previously diagnosed with hypertension, were markedly higher in Can Tho and HCMC, and among men from Ha Noi. Including those on prescribed medication or previously diagnosed with hypertension in the definition of raised blood pressure increased the estimated national proportion with raised blood pressure by around four percentage points with the largest increases in Can Tho, HCMC and Ha Noi (men). Doing so also substantially reduced its uncharacteristic positive association of the provincial proportions with physical activity for men, and reversed each of the other anomalous associations. A demonstration of how this occurred for mean BMI is presented in Figure 2.1.

With raised blood pressure defined to include those on prescribed medication or otherwise previously diagnosed with hypertension, the estimated national proportion with raised blood pressure is around four percentage points higher with the largest increases in Can Tho, HCMC and Ha Noi (men).

There were other unexpected associations for current smoking among men. Figure 2.2 shows that higher proportions of ex-smokers than never-smokers or current smokers had elevated blood pressure and glucose. Including ex-smokers with never-smokers in the reference category produced the anomalous finding of a negative association between current smoking and hypertension.

Table 2.4. Participants who reported taking prescribed medication for raised blood pressure (BP) or having been diagnosed previously with hypertension, and estimated prevalence of hypertension with these factors taken into account

	Thai Nguyen	Hoa Binh	Ha Noi	Hue	Binh Dinh	Dak Lak	HCMC	Can Tho	Total
	Mean95%CI	Mean95%CI	Mean95%CI	Mean95%CI	Mean95%CI	Mean95%CI	Mean95%CI	Mean95%CI	Mean95%CI
Men									
BP medication [a]	0.82 ±0.64	1.57 ±1.71	1.71 ±0.61	1.56 ±0.59	1.32 ±0.56	1.89 ±1.25	3.98 ±1.28	4.23 ±1.62	2.35 ±0.49
Prior diagnosis [b]	6.70 ±1.75	6.32 ±2.10	7.96 ±2.14	5.55 ±1.41	5.59 ±1.35	6.23 ±1.98	10.1 ±1.96	12.4 ±2.79	8.21 ±0.88
Raised BP 1[c]	20.1 ±3.33	20.2 ±2.74	15.7 ±3.01	16.2 ±3.09	21.5 ±3.27	25.5 ±3.77	17.3 ±3.10	17.0 ±3.11	18.5 ±1.29
Raised BP 2[d]	20.3 ±3.31	21.3 ±3.62	16.2 ±3.03	16.9 ±3.06	21.6 ±3.28	25.8 ±3.77	19.3 ±3.19	18.8 ±3.35	19.4 ±1.38
Raised BP 3[e]	21.9 ±3.12	22.7 ±3.75	19.8 ±3.50	18.6 ±3.16	22.8 ±3.22	27.0 ±3.72	23.7 ±3.36	23.6 ±3.42	22.4 ±1.51
Women									
BP medication [a]	1.29 ±0.52	1.50 ±1.02	2.52 ±0.94	3.48 ±1.01	2.97 ±0.82	2.07 ±1.31	4.49 ±1.26	7.95 ±1.95	3.55 ±0.47
Prior diagnosis [b]	5.69 ±1.63	5.54 ±4.51	6.82 ±1.56	8.18 ±1.63	7.92 ±1.40	8.66 ±2.85	8.53 ±1.86	15.9 ±2.23	8.75 ±0.81
Raised BP 1[c]	9.05 ±2.43	11.8 ±3.28	7.69 ±1.66	9.93 ±1.88	10.4 ±1.91	15.7 ±3.64	9.09 ±1.82	13.3 ±2.19	10.2 ±0.85
Raised BP 2[d]	9.64 ±2.47	12.0 ±3.27	8.51 ±1.72	10.8 ±1.90	11.1 ±1.80	16.0 ±3.64	11.1 ±2.07	16.9 ±2.37	11.5 ±0.90
Raised BP 3[e]	11.2 ±2.52	15.2 ±4.58	10.9 ±1.98	13.2 ±2.08	13.0 ±1.77	18.9 ±3.66	14.2 ±2.30	22.7 ±2.55	14.6 ±1.01

a. Taking medication for raised blood pressure, as indicated by a positive responses to the question “During the past two weeks, have you been treated for raised blood pressure with drugs (medication) prescribed by a doctor or other health worker?”

b. Previously diagnosed with hypertension, as indicated by a positive response to the question “Have you ever been told by a doctor or other health worker that you have raised blood pressure or hypertension?”

c. Systolic blood pressure ≥140 mm Hg and/or diastolic blood pressure ≥90 mm Hg.

d. Systolic blood pressure ≥140 mm Hg and/or diastolic blood pressure ≥90 mm Hg or taking medications for hypertension.

e. Systolic blood pressure ≥140 mm Hg and/or diastolic blood pressure ≥90 mm Hg or taking medications for hypertension or previously diagnosed with hypertension.

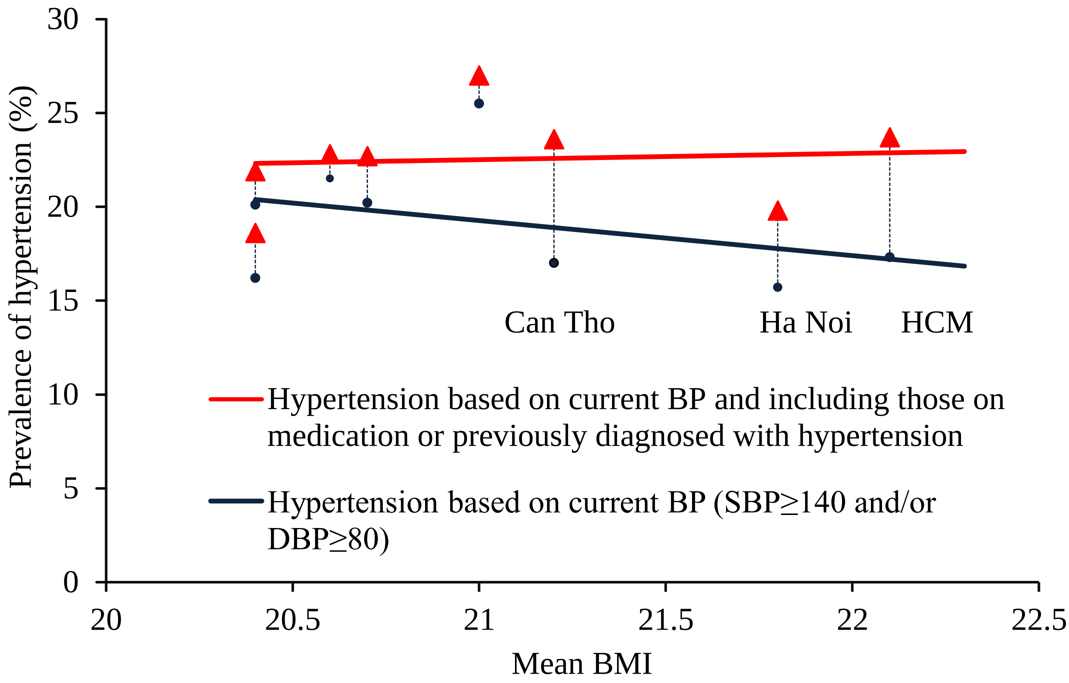

Figure 2.1. Associations between provincial proportions of men with hypertension and provincial mean BMI of those men

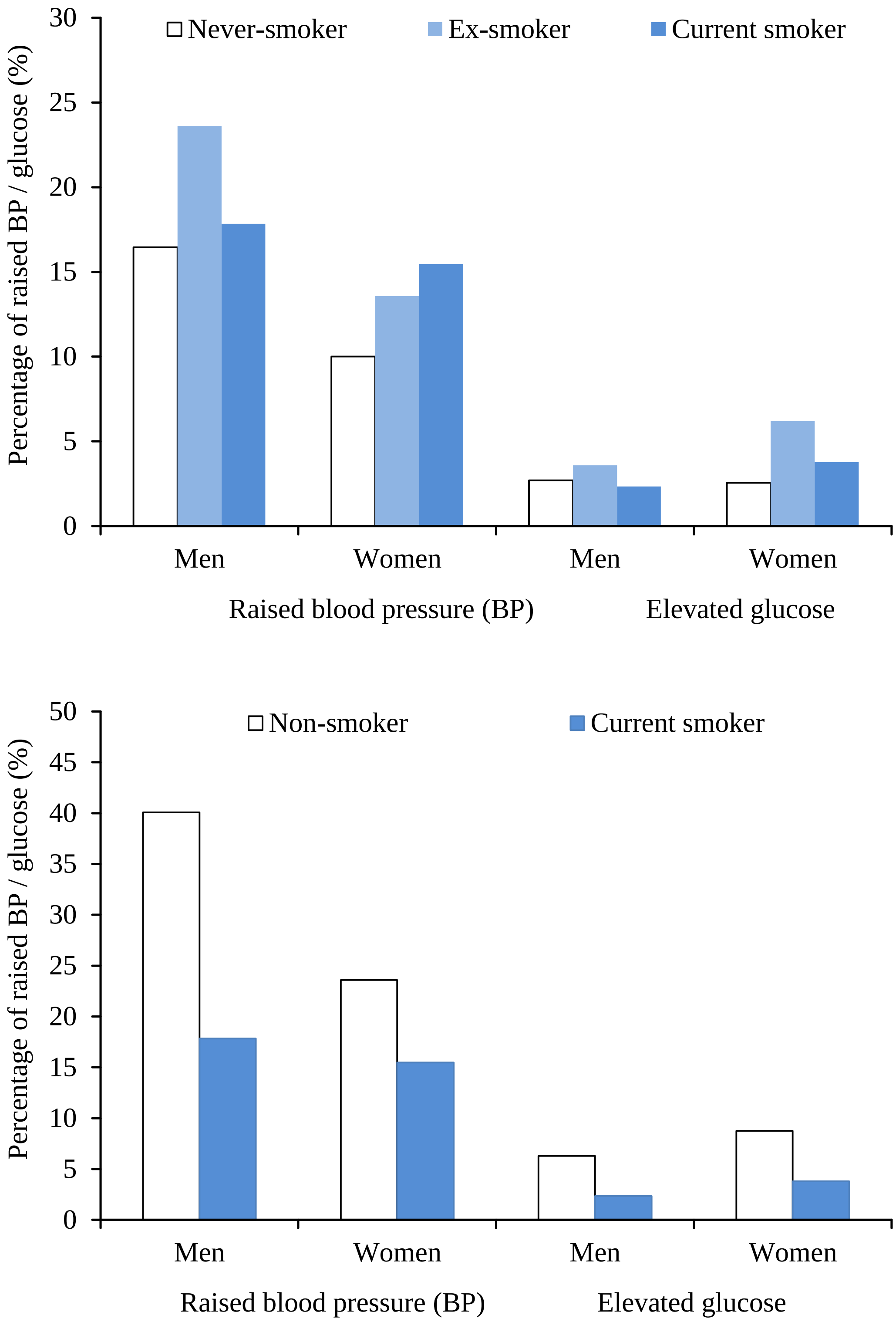

Figure 2.2. Proportions of respondents with raised blood pressure (BP) and elevated glucose classified by smoking status (Top: never-, ex- and current smoker; Bottom: non- and current smoker)

2.5 Discussion

This paper presents the first comprehensive account of the regional distribution of NCD risk factors in Vietnam made in a standardised way. Participants in the survey were selected using population-based sampling from eight provinces representing eight different geographical regions of Vietnam according to WHO STEPS protocols (17). Our findings reflect some known regional attributes and social characteristics of the country, and document in aggregate some of the health-related consequences for a developing country in the early stages of economic transition. For the most part, the directions of the associations found in aggregate between provincial levels of the risk factors were as expected from sociological, epidemiological and biological evidence about plausible causal pathways. However, there were unexpected associations with smoking and hypertension. These were due to the characterisation of smoking and hypertension by STEPS protocols.

The information on socio-demographic characteristics mostly accords with official statistical records of the Vietnamese population (16, 23). The lifestyle characteristics also reflected some of the cultural practices of the country. More than one-half of the men were current smokers and around a quarter of men participated in heavy drinking occasions, whereas those behaviours were rare among women. This has been described previously (3, 8, 24, 25). Higher proportions of men than women had high levels of physical activity, which is consistent with results of previous studies in Ha Noi (26), HCMC (7), and Can Tho (9). Non-Kinh subjects living in predominately rural locations were relatively physically active and lean on average. The women among them tended to have higher servings of fruit/vegetables than their Kinh counterparts.

The summary information on health-related behaviours and pathophysiological outcome factors demonstrates the changing NCD risk factor profile of a country undergoing demographic and economic transition. For example, greater schooling and income was associated with reduced smoking, less hazardous/harmful alcohol intake and improved diets on the one hand, and reduced physical activity and higher BMI on the other, in line with previous research on socioeconomic factors and smoking (27), at-risk drinking (25), and improved fruit/vegetable intake (28), physical activity (7, 26), and BMI (6, 15). The proportions of active people were inversely correlated with the proportion of urban-dwellers. For instance, activity proportions were lowest in Can Tho (two-thirds urban) and HCMC (around 80% urban). These provinces had the highest mean BMI, highest proportions with elevated glucose and highest mean cholesterol. These correlations between provincial levels of physical activity, BMI, elevated glucose and cholesterol consistent in sign with results at the individual level.

The regional and sex differences in the NCD risk reflect the socio-demographic and cultural characteristics of the country. Smoking and binge drinking were largely confined to men, and to those with lower levels of education. Fruit and vegetable and vegetable intake was higher among persons with higher income. Vegetable consumption was greater in northern provinces, and physical activity was lower in urban areas. These observations attest to the construct validity of the STEPS questionnaire for use in Vietnam. Furthermore, the relationships between risk factors discussed to this point appear sociologically and biologically plausible. Whilst our data are cross-sectional, the associations are consistent with the changing risk factor profile of a developing country undergoing industrialization/urbanisation. Vietnam has experienced increasing urbanisation in recent years (29), with increased adiposity and hypertension a predicted consequence (14, 15). The process of transition from a traditional/rural to a more modern/urban society is accompanied by a shift from physically active occupations such as farming and forestry toward more sedentary, office-based occupations. For example, national survey data from China during 1991–2006 (30) showed that more than four-fifths of the decline in occupational physical activity for men and nearly two-thirds of the decline for women were predicted by factors associated with urbanisation (e.g. population size and economic well-being). Other research findings have suggested that urbanisation is associated with a higher prevalence of overweight/obesity (31, 32), hypertension (32), and diabetes (31).

The summary estimates for each province were presented in a report prepared for the Ministry of Health of the Socialist Republic of Vietnam, and stored also on a database that could be accessed by staff of the Ministry of Health and of the provincial health authorities. It soon became clear that one of the principal uses of the paper-based and electronic information would be to draw associative inferences (e.g. “the mean level of physical activity in our province is higher than that in other provinces, so is our mean BMI correspondingly lower?”). Aware of this, summary provincial estimates of NCD risk factors and measures of association (correlations) between those summary estimates are presented, together with a warning (by way of footnotes to Table 2.3) when the provincial-level correlations are not consistent with individual-level associations. The provincial-level associations were generally greater in magnitude than the individual-level associations, however, and in highlighted cases the exaggeration was pronounced. This serves as a first warning about drawing associative inferences from the aggregate data: the provincial-level associations in this study were overstated in the main. A second warning is that in some cases the relationships were not plausible. This was the case for two sets of relationships, and an explanation is provided for each.

The first set of implausible relationships occurred for tobacco smoking. For women, the proportions of smokers (and binge drinkers) were so low that minor differences in proportions have to be discounted due to sampling error. For men, current smoking was inversely related to the proportions with raised blood pressure and glucose because those at highest risk were ex-smokers. Our group identified the hypertension phenomenon previously in a survey in Can Tho (10), and proposed that this was likely due to smokers being prompted to quit by a diagnosis of hypertension. The STEPS protocols allow information to be captured on ex-smokers, but the core instrument refers exclusively to current smokers and the survey report template requires reporting only of the proportion of current daily smokers and their years of smoking and quantities smoked. Our results indicate that information solely on current smokers does not accurately portray the risk profiles of Vietnamese men.

The second anomaly related to raised blood pressure assessed in accordance with STEPS protocols (SBP ≥140 mmHg and/or DBP ≥90 mmHg). While the prevalence of uncontrolled raised blood pressure is an important health system indicator, our results demonstrate that this definition may lead to implausible associations with other risk factors including high physical activity, mean BMI and cholesterol. The implausible associations were resolved by including those using medication for, or previously diagnosed with, hypertension in the definition of raised blood pressure. We would therefore encourage those using STEPS protocols to consider the definition of raised blood pressure that is appropriate for their population, and to be aware that the use of the recommended definition may cause spurious associations. With this expanded definition, our estimates for Vietnam (22.4% for men and 14.6% for women) are more similar to those from a previous multi-province study (24.1% for men and 17.9% for women aged 25–64 years) (13) that included relatively more participants from urban areas (where hypertension is more prevalent). Our sample accurately reflected the urban-rural population division.

This was the first ecological analysis of the population prevalence of NCD risk factors in Vietnam using a representative sampling frame. To minimise avoidable sources of random error and bias, the measurements were made by trained staff in accordance with standardised protocols designed specifically by WHO for providing data that are culturally-relevant yet valid for international comparisons. The aggregate estimates were shown to have evidence of construct validity and, for the most part, associative validity because relationships between risk factors were of the expected sign. Further, confirmation was provided of the utility of STEPS protocols for the intended purpose of providing aggregate data for valid inter-country comparisons albeit through the prism of intra-country comparisons.

Nevertheless, our study has limitations. First, whilst the response proportion (64%) was high for a study requiring lengthy clinic attendance with invasive procedures including blood-sampling, it was nevertheless low enough to allow the possibility of non-participation bias. Second, information providing a more thorough understanding of the relationships studied – such as dietary fat, 24-hour urinary sodium, physical activity by objective methods, and ambulatory blood pressure – was not collected. The STEPS method emphasises that small amounts of good quality data are more valuable than large amounts of poor quality data, and focuses on a limited range of data collection made in the best manner possible in large-scale fieldwork. Third, each of the measurements has several alternative forms or quantitative scales, and reporting each is impractical within this limited space. We followed STEPS protocols where possible, and used principal components analysis to select a single indicator per risk factor, and reported more fully in two cases (current smoking and hypertension) when the choice was nuanced or resulted in misinterpretations. This highlighted the importance of the definition of hypertension but, as a fourth limitation, we cannot discount that other factors such as measurement errors (perhaps due to faulty recall or to poor equipment or technique in diagnosis) can account for the sizeable numbers of respondents reporting a previous diagnosis of hypertension in HCMC and Can Tho, despite their blood pressure measurement with automated equipment in accordance with strict protocols in this survey being below the thresholds. A sixth limitation is that data were collected by provincial data collection teams, and inter-team measurement variation cannot be excluded as a contributing factor for part of the differences found between ecological regions. Finally, we tested the validity of the summary estimates for inter-country comparisons through the prism of inter-province comparisons within one country. This is reasonable because the provinces of Vietnam differed widely in terms of socio-demographic factors. Nevertheless, inter-country comparisons could involve considerably more heterogeneity than this.

2.6 Conclusions

In summary, this study provides an extensive description of the sex-specific and regional distribution of NCD risk factors in Vietnam and a fascinating account of some health-related consequences of the early stages of urbanisation/industrialization in a developing country. The findings provide information that will be valuable in guiding the development of public health policy in respect of NCDs in Vietnam. In addition, they lend support to the case that STEPS protocols have utility for the intended purpose of providing aggregate data for valid between-population comparisons, but with important caveats identified.

2.7 Postscript

The research presented in this chapter has provided an extensive description of the regional distribution of eight NCD risk factors in Vietnam, and a fascinating account of some health-related consequences of industrialization in its early stage. Findings also show that the STEPS protocols can be utilised to provide aggregate data for valid between-population comparison. Because nationally-representative data on smoking prevalence are not available in Vietnam, additional data on tobacco smoking will be presented in the next chapter.

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Chapter 3. Declining prevalence of tobacco smoking in Vietnam

3.1 Preface

The previous chapter presented the mean levels or prevalence of eight risk factors at the provincial and national levels, and assessed whether summary estimates of those risk factors measured by the WHO STEPS protocols provide plausible associations. Nationally-representative data on tobacco smoking are not available. This chapter provides additional data on tobacco use in Vietnam in 2010. By using a re-constructed birth cohort analysis method, estimates of smoking prevalence of five year birth cohort groups in calendar periods are made and the potential explanations for trends found are also presented. The contents of this chapter have been published in the *Nicotine and Tobacco Research (1)*.

3.2 Introduction

Tobacco use is the leading preventable cause of premature death and disability worldwide (2). The World Health Organization estimates that nearly six million people die each year worldwide from tobacco-related causes (2). The burden of tobacco is currently greatest in high-income regions (i.e. North America, Western Europe), but lower in low-income regions (i.e. south-east Asia) (3). Nevertheless, global patterns in tobacco use have changed, and smoking prevalence is reported to be declining in most developed countries but increasing in many developing countries (4). The proportion of deaths from tobacco smoking is expected to increase in the coming decades, particularly in developing countries (2). If current trends continue, death tally is projected to about eight million per year by 2030, with 80% of these premature deaths occurring in the developing world (2).

High-quality data on smoking in the developing world are limited. Such data are important for planning and evaluation of tobacco control initiatives. They are also required to estimate the burden of tobacco-related diseases over time. Additional data reflecting current tobacco usage patterns of change over time, and differences between birth cohorts, are all important. Age-specific data alone is inadequate because it can obscure patterns and changes. For example, reduced smoking prevalence among persons of more recent birth cohorts could be masked. Prior studies in developed countries have identified changes in smoking prevalence occurring in different time periods or birth cohorts citing factors such as improved education and tobacco control initiatives (5-7). Analysis of birth cohort trends in tobacco smoking and its correlates are rare in developing countries such as Vietnam. Furthermore, nationally-representative data on smoking patterns and levels of exposure over time among smokers in Vietnam currently are limited.

To address this critical lack of information for Vietnam, this study aimed to estimate smoking prevalence and the levels of its exposure using a nationally-representative Vietnamese sample, investigate trends in smoking prevalence using reconstructed birth cohort analysis, and explore potential explanations for any trends found.

3.3 Methods

3.3.1 Study participants and sampling

The data are from a population-based survey of risk factors for NCDs in Vietnam in 2009–2010 that was designed in accordance with the STEPS method (8). The two-stage sampling procedure involved selecting 20 clusters (communes, towns, and city wards) from each of eight geographically-representative provinces with probabilities proportional to population size from four strata defined by urban-rural location and rich-poor classification. For each selected cluster, the provincial health authority prepared a comprehensive listing of residents aged 25−64 years. From those lists, an adequate number of persons were selected in age and sex stratum to provide 17–24 persons in each age group (25−34 years, 35−44 years, 45−54 years, 55−64 years) and sex (male, female) stratum, and 140 per cluster overall. These persons were invited to attend a clinic on a specific date, each commencing in the early morning because overnight fasting was required. Measurements were made and questionnaires were administered by trained staff of each provincial health authority. Training of field staff was conducted pre-survey at training centres in Ha Noi, Hue and Ho Chi Minh city, and on-site at regular intervals by local, national and international supervisors. Eligible subjects were provided with an information sheet about the study, and were required to sign a consent form if they agreed to participate. Of the 22,940 eligible subjects aged 25–64 years, 14,706 participated (response proportion 64.1%). The protocol of this survey was approved by the Ethics Committee of Vietnam Ministry of Health and the Tasmanian Health and Medical Human Research Ethics Committee. Informed consent was obtained from participants.

3.3.2 Measurements and data analysis

The WHO STEPS questionnaire (8) was used to collect data on smoking behaviour and socio-demographic factors. It was translated into Vietnamese and back-translated to ensure the appropriate meaning of each item was retained. It sought information on whether respondents had ever smoked any combustible tobacco products on a daily basis and, if so, the age at which they had commenced smoking and the types and quantities of tobacco products they had smoked. Former daily smokers were additionally asked to recall the age at which they had quit smoking. Non-daily smokers were not asked to provide this information. For analysis, respondents were classified as current daily smokers, former daily smokers, current and former non-daily smokers, and never-smokers. Years (duration) and pack-years of smoking (cigarettes per day ÷ 20 × duration in years) were calculated for current and former daily smokers. An additional question asked about current use of chewing tobacco. The age at which users started to use chewing tobacco, and the age if any at which they stopped doing so, were not collected.

Self-reported highest education levels were categorised as less than primary (<5 years), primary (5–8 years), junior secondary (9–11 years), senior secondary (12 years), and college/undergraduate or postgraduate (>12 years). On the basis of year of birth, each respondent was classified into one of eight birth cohorts: 1945–49, 1950–54, 1955–59, 1960–64, 1965–69, 1970–74, 1975–79 and 1980–84. Log multinomial regression (9) was used to estimate prevalence ratios (PRs) of each category of tobacco smoking at levels of study factors, and adjusted for age. To enable comparison of birth cohorts on a like-for-like basis (Figure 3.1), the classification of smoking is based on smoking status at age 25 years (the age of the youngest respondents in this survey).

Age-cohort-period modelling was used to estimate the effects of age, cohort and time period on smoking prevalence. The associations between education and smoking were conducted to better understand the trends. These analyses are detailed in the Appendix 3.A. Briefly, the smoking status of each subject in each year of life (and corresponding age) was determined from the reported age of onset of smoking and, for quitters, the reported age of quitting. The annual observations were then categorised into 5-year age groups and 5-year birth cohorts, with period calculated as period = cohort + age. Correction for differential mortality of smokers and never-smokers (7, 10) was made using the official life table for Vietnam. Smokers were assumed to progressively attain a 30% increased risk (11) of mortality for current smokers relative to never-smokers after 10 years of smoking. Risk among quitters was assumed to progressively return to the risk of never-smokers over 20 years (12, 13). The contributions of age, period and cohort were estimated by binary regression of smoking status indicators on binary (0/1), covariates for age and binary linear and quadratic covariates for period and cohort. To estimate the effects of education on smoking trends, log binomial (14) and log multinomial (9) regressions were used to estimate the probability of ever being a smoker or of category of smoker at each year of education. Furthermore, mean cigarettes/day and duration were estimated at four ages (30 years, 40 years, 50 years and 60 years) from the information provided on year of onset, year of quitting (former smokers) and cigarettes/day. Cumulative quantity smoked at those ages was assessed in pack-years. Age of onset, cigarettes/day, duration and pack-years are right skewed, and therefore medians and interquartile ranges (IQRs) are presented. All analyses were performed using complex survey methods provided by Stata version 12.0.

3.4 Results

Selected characteristics of the study participants, stratified by sex, are presented in Table 3.1. The study sample consisted of 14,706 (53.5% female) subjects, with participation proportions highest for 55−64 year olds (70.5%) and lowest for 25−34 year olds (men 42.0%, women 57.6%) who are the most mobile for reasons of work. Women had completed less education than men.

Table 3.1. Characteristics of subjects

	Men	Women
Characteristic	Weighted % (n/N)	Weighted % (n/N)
Age groups		
25–34 years	35.9% (1423/6804)	34.2% (1745/7902)
35–44 years	30.5% (1666/6804)	29.2% (1925/7902)
45–54 years	22.9% (1791/6804)	24.0% (2146/7902)
55–64 years	10.8% (1924/6804)	12.6% (2086/7902)
Education completed		
Less than primary	15.0% (1048/6785)	23.7% (2168/7885)
Primary	27.2% (1830/6785)	26.8% (2104/7885)
Secondary	28.8% (2051/6785)	25.3% (1941/7885)
Senior secondary	14.3% (943/6785)	12.6% (850/7885)
College/University+	14.6% (913/6785)	11.5% (822/7885)
Smoking status		
Never-smoker	25.1% (1723/6782)	97.4% (7551/7886)
Non-daily	5.6% (323/6782)	0.5% (43/7886)
Former daily smoker	14.4% (1190/6782)	0.5% (70/7886)
Current daily smoker	54.9% (3546/6782)	1.7% (222/7886)
Age of smoking onset*		
Former daily smoker	18.0 (17.0,20.0)	20.0 (18.0,30.0)
Current daily smoker	19.0 (17.0,22.0)	20.0 (17.0,26.0)
Smoking duration*		
Former daily smoker	17.0 (10.0,24.0)	26.0 (16.0,36.0)
Current daily smoker	19.0 (12.0,28.0)	25.0 (14.0,34.0)
Number of cigarettes/day*		
Former daily smoker	10.0 (6.0,20.0)	4.0 (2.0,10.0)
Current daily smoker	10.0 (7.0,20.0)	9.0 (5.0,10.0)
Pack-years*		
Former daily smoker	9.0 (4.0,18.0)	9.2 (4.5,13.0)
Current daily smoker	10.0 (5.0,19.0)	8.0 (4.0,12.5)
Type of tobacco product		
Manufactured cigarettes	89.0% (2972/3546)	70.3% (113/222)
Hand rolled cigarettes	0.5% (21/3546)	18.0% (34/222)
Water pipe	12.7% (628/3546)	12.1% (72/222)
Pipes of full tobacco	0.04% (3/3546)	0.7% (2/222)
Cigars	0.1% (2/3546)	– –
Current smokeless tobacco use	0.6% (46/6781)	0.6% (109/7878)

*Medians and interquartile ranges

Smoking prevalence was much higher for men than women. The percentage of ever-smokers was 74.9% among men but 2.6% among women. Male ever-smokers commenced smoking at median age of 19.0 (IQR 17.0, 21.0) years and smoked median quantities of 10.0 (IQR 7.0, 20.0) cigarettes/day, and they had accumulated median exposures of 19.0 (IQR 12.0, 27.0) years of smoking and 9.8 (IQR 5.0, 18.8) pack-years of cigarettes. Female ever-smokers commenced smoking at median age of 20.0 (IQR 18.0, 26.0) years, smoked median quantities of 6.0 (IQR 4.0, 10.0) cigarettes/day, and they had accumulated median exposures of 25.0 (IQR 14.0, 33.0) years of smoking and 8.0 (IQR 4.1, 12.5) pack-years of cigarettes. Separate estimates for current daily and former daily smokers are provided in Table 3.2. The most commonly consumed tobacco product was manufactured cigarettes (men 90.0%, women 70.3%), followed by water pipe cigarettes for men (12.7%), and hand rolled cigarettes for women (17.9%).

Table 3.2 presents sex-stratified PRs for factors likely to be associated with smoking status. Current daily smokers were more often older (women only), and less well-educated. Former daily smokers were older, and better educated (men). Non-daily current or former smokers were generally younger, and better educated (men). Never-smokers, the category excluded from regression analysis, were among better educated groups. The proportions of never-smokers increased in each successive age category for women, and for all categories but the oldest (55–64 years) for men.

For men, the proportion of current daily smokers peaked in the 1965–69 cohort and has declined in more recent cohorts. The proportion of never-smokers reached its lowest point in the 1965–69 cohort and has subsequently increased in more recent cohorts (Figure 3.1). For women, the proportion of current daily smokers has declined in successive cohorts after the 1950–54 cohort (Figure 3.1).

Table 3.2. Factors associated with smoking status by sex

	Never-smoker	Non-daily smoker		Former daily smoker		Current daily smoker	
	% (n/N)	% (n/N)	PR (95%CI)*	% (n/N)	PR (95%CI)*	% (n/N)	PR (95%CI)*
Men							
Age groups							
25–34 years	33.7% (500/1419)	7.6% (103/1419)	1.0	7.6% (126/1419)	1.0	51.1% (690/1419)	1.0
35–44 years	18.9% (367/1661)	4.3% (68/1661)	0.6 (0.4,0.9)	15.9% (277/1661)	2.1 (1.6,2.8)	60.9% (949/1661)	1.2 (1.1,1.3)
45–54 years	21.3% (385/1789)	3.9% (65/1789)	0.5 (0.3,0.8)	20.1% (359/1789)	2.7 (2.0,3.5)	54.6% (980/1789)	1.1 (1.0,1.2)
55–64 years	22.0% (471/1913)	6.0% (87/1913)	0.8 (0.5,1.2)	20.7% (428/1913)	2.7 (2.1,3.6)	51.3% (927/1913)	1.0 (0.9,1.1)
Trend			p=0.03		p<0.01		p=0.51
Education levels†							
< Primary	21.2% (240/1045)	3.1% (22/1045)	1.0	11.7% (149/1045)	1.0	64.1% (634/1045)	1.0
Primary	21.5% (390/1826)	2.8% (59/1826)	0.9 (0.4,2.0)	14.7% (322/1826)	1.4 (1.0,1.8)	61.0% (1055/1826)	1.0 (0.9,1.0)
Secondary	23.4% (491/2045)	6.7% (103/2045)	2.2 (1.0,4.8)	15.5% (369/2045)	1.3 (1.0,1.7)	54.4% (1082/2045)	0.8 (0.8,0.9)
Senior secondary	29.6% (288/940)	8.9% (67/940)	2.7 (1.2,6.0)	12.7% (161/940)	1.2 (0.9,1.7)	48.8% (424/940)	0.8 (0.7,0.9)
College/Uni+	35.2% (308/908)	7.7% (70/908)	2.2 (1.0,5.0)	16.2% (186/908)	1.6 (1.2,2.2)	40.9% (344/908)	0.7 (0.6,0.8)
Trend			p<0.01		p=0.02		p<0.01
Women							
Age groups							
25–34 years	98.6% (1720/1743)	0.6% (9/1743)	1.0	0.1% (1/1743)	1.0	0.7% (13/1743)	1.0
35–44 years	98.0% (1878/1922)	0.3% (6/1922)	0.4 (0.1,1.2)	0.4% (9/1922)	4.0 (0.5,34.8)	1.3% (29/1922)	1.9 (0.9,4.3)
45–54 years	96.9% (2054/2144)	0.6% (13/2144)	0.9 (0.3,2.6)	0.2% (7/2144)	2.2 (0.3,19.3)	2.3% (70/2144)	3.5 (1.7,7.3)
55–64 years	93.5% (1899/2077)	0.5% (15/2077)	0.7 (0.3,1.9)	2.0% (53/2077)	19.2 (2.6,142.3)	4.0% (110/2077)	6.1 (3.1,12.3)
Trend			p=0.69		p<0.01		p<0.01
Education levels†							
< Primary	95.0% (1996/2164)	0.8% (15/2164)	1.0	0.8% (31/2164)	1.0	3.5% (122/2164)	1.0
Primary	97.9% (2025/2101)	0.5% (12/2101)	0.6 (0.2,1.8)	0.4% (16/2101)	0.8 (0.3,2.3)	1.3% (48/2101)	0.5 (0.3,0.8)
Secondary	98.2% (1881/1940)	0.2% (7/1940)	0.2 (0.1,0.9)	0.3% (12/1940)	0.5 (0.2,1.6)	1.4% (40/1940)	0.5 (0.3,0.8)
Senior secondary	98.0% (829/847)	0.7% (4/847)	0.8 (0.2,3.7)	0.6% (7/847)	1.3 (0.3,6.1)	0.8% (7/847)	0.3 (0.1,0.8)
College/Uni+	99.2% (807/817)	0.2% (3/817)	0.3 (0.0,1.3)	0.2% (3/817)	0.5 (0.1,2.1)	0.4% (4/817)	0.1 (0.0,0.5)
Trend			p=0.24		p=0.62		p<0.01

*PR(95 %CI): prevalence ratios (95% confidence interval); %: weighted percentages; †education levels are adjusted for age

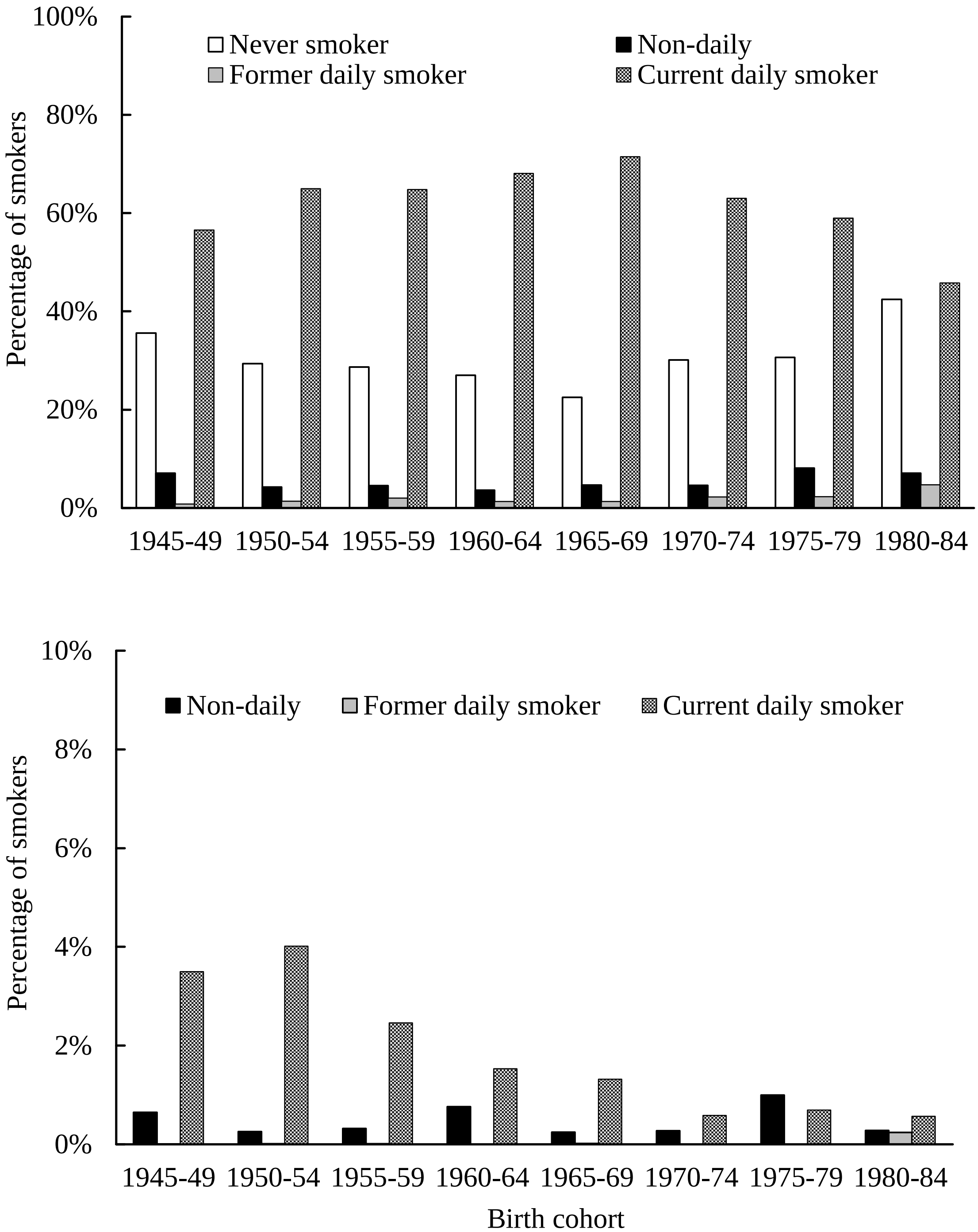
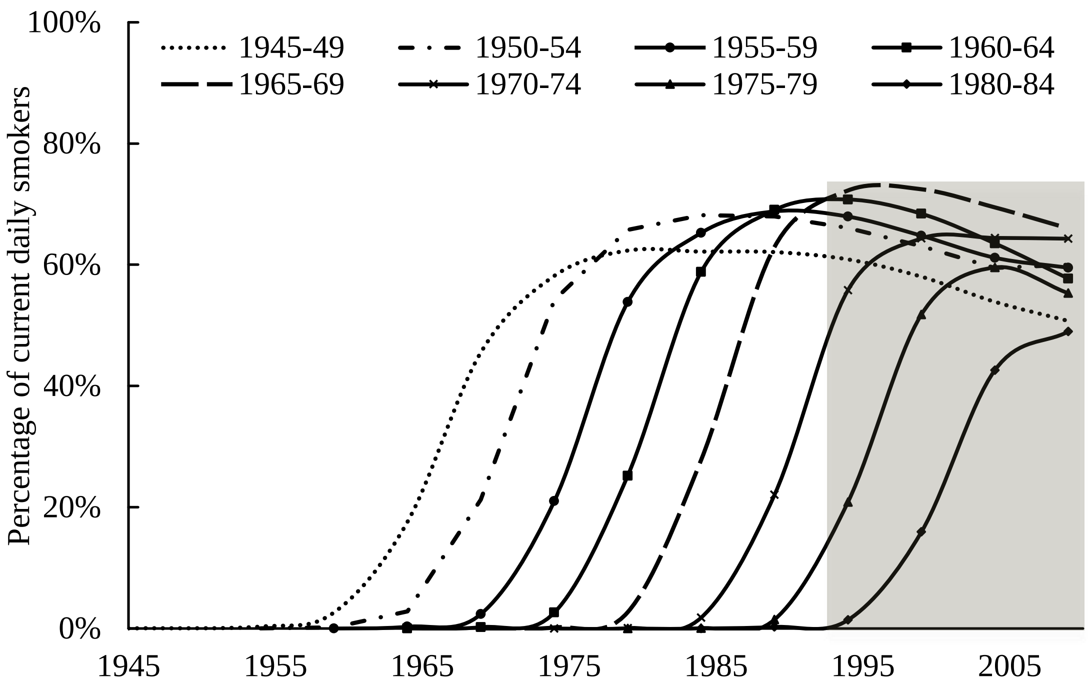


Figure 3.1. Prevalence of smoking at age 25 among men (top) and women (bottom)

Cohort-specific estimates of prevalence of current daily smoking from 1945 to 2009 are presented in Figure 3.2. These estimates are corrected for excess mortality among smokers (details are provided in the Additional Table 3.B), with the corrections producing less than one percentage point of change in prevalence in each age-period-cohort category. For men, smoking prevalence peaked in the 1965–69 cohort, and mirroring the pattern seen in Figure 3.1, each successive cohort has reached a lower peak. In age-period-cohort modelling, however, age-period models fitted the data equally as well as age-cohort models. From the fit of an age-period model with quadratic period trend ($p=0.009$), the decline was estimated to have commenced in 1990 (95%CI 1982, 1997). For women, most cohorts did not reach the higher proportion of smokers achieved by those of the preceding cohort at the same age. These corrections for excess mortality were not sensitive to the assumption made about the latency period (replacing the assumed lag of 10 years between onset of smoking and attainment of maximum risk of mortality with 5 or 20 years made almost no difference to the estimates). Increasing the relative risk from 1.3 to 1.5 or 2.0 increased the prevalence estimates in the older cohorts by at most one percentage point.

In further investigation of smoking trends, we estimated the probability of smoking from information on each participant's years of education. For men, the probability of smoking decreased with each additional year of education ($p<0.001$), and more markedly for those born after 1969 (ever-smoking $p<0.001$, current daily smoking $p=0.017$) than for those born in the 1960s. These people commenced smoking around 1990 or thereafter. For women, the probability of ever being a smoker reduced significantly with each additional year of education ($p<0.001$) and tended to be stronger in more recent cohorts without the interaction reaching statistical significance given the relatively small numbers of women who smoked.

The distribution of smoking characteristics at ages 30 years, 40 years, 50 years and 60 years was estimated to investigate the levels of exposure among ever-smokers (see Additional Table 3.B). The median of cigarettes/day was stable across those ages (males 10.0, females 5.0). In contrast, there were fairly linear increases in smoking duration and pack-years with age. For example, male ever-smokers aged 30 years had accumulated median exposures of 11 (IQR: 8.0, 13.0) years of smoking and 6.0 (IQR: 2.5, 10.0) pack-years of cigarettes, whereas those aged 60 years had accumulated median exposures of 39.0 (IQR: 32.0, 42.0) years of smoking and 21.0 (IQR: 11.5, 36.0) pack-years of cigarettes. Among the relatively few female smokers, there was a similar linear increase in duration across ages. However, they had accumulated less than half the pack-years of men due to low median cigarettes/day.



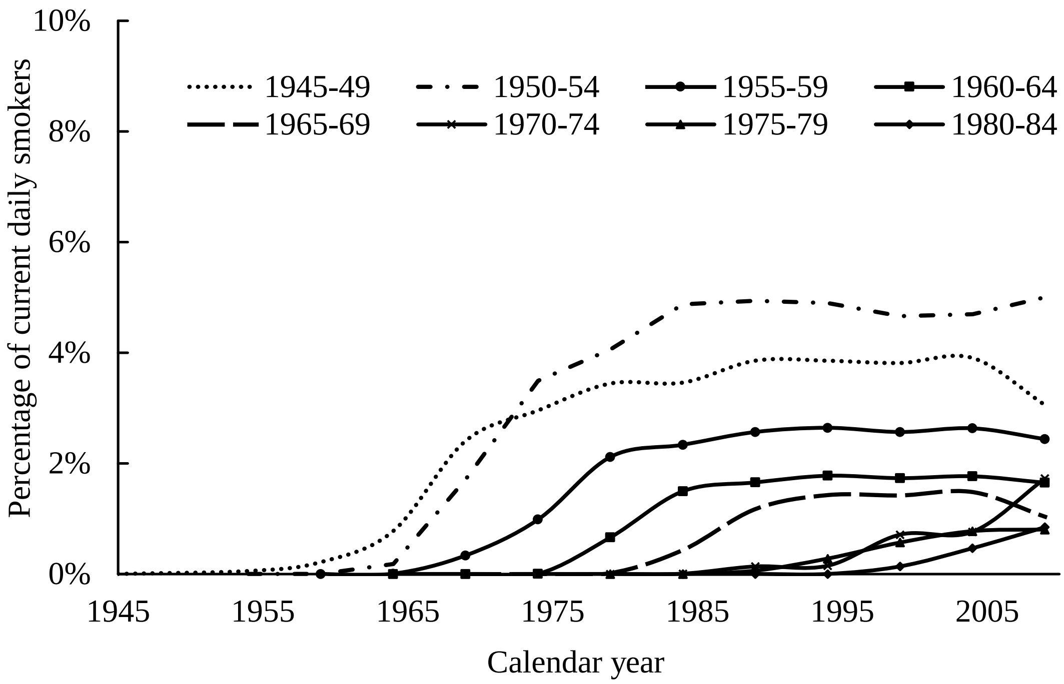


Figure 3.2. Prevalence of current daily smoking by 5-year birth cohort and 5-year calendar period among men (top) and women (bottom)

3.5 Discussion

Prompted by concerns about an emerging tide of tobacco-related premature deaths in developing countries (2), this study reports prevalence estimates of tobacco smoking in Vietnam made from nationally-representative data collected using the standardised procedures of the STEPS methodology (8). Three-quarters of 25–64 year-old men in 2010 were ever-smokers, but smoking remains relatively rare among women, as described in a previous multi-province study of Vietnam (15). A new and encouraging finding is that the prevalence of current daily smoking has declined in the most recent birth cohorts of men, and has declined across almost all cohorts of women. The recent declines for men are possibly in response to local and global tobacco control initiatives in the 1990s with impacts on all cohorts. Despite smoking only moderate number of cigarettes/day, Vietnamese smokers had accumulated similar aggregate exposures to their counterparts in Western countries because relatively few had quit.

This is the first finding of a reversal of trend of increased smoking prevalence among men in south-east Asia. Despite predictions of increased prevalence in low- and middle-income countries (4), the present finding indicates a decline in the proportion of male smokers in the most recent birth cohorts studied (those born during the mid-1960s and the mid-1980s). An age-period-cohort analysis of smoking in Thailand also reported decreasing prevalence in cohorts of men but surprisingly, across all cohorts studied (birth years 1902–96) (16). A previous study in Vietnam, using multi cross-sectional survey data collected with varying sampling strategies, found unchanged prevalence among men during 2001–09 (17), but cohort-specific estimates were not presented. In Japan, the economically most advanced country of the region during the relevant period, two cohort analyses suggest that smoking prevalence peaked for men born in the 1920s and has declined in subsequent cohorts (18, 19). This timing matches that found in the USA (6, 10), UK (20), and Canada (21). The pattern of increasing then decreasing prevalence is in general agreement with the model of smoking diffusion for those countries proposed by Lopez and colleagues (22). Our results suggest that the peak was delayed by around 40 years in Vietnam, again in keeping with the predictions of the WHO model for south-east Asian countries (23).

For the relatively few Vietnamese women who smoked, our results suggest that smoking prevalence has declined in consecutive cohorts. There is no evidence of the lagged (relative to men) increases in prevalence for women predicted by the smoking diffusion model based on Western experience (6, 7, 10, 20, 21), and predicted to be a consequence of increased marketing efforts by tobacco companies in developing countries (24). Less than five percent in all cohorts of Vietnamese women smoked despite high proportions of smokers among their male counterparts. This may reflect social mores on smoking by women in Asia, also experienced by women in Africa, the Pacific and Latin America (25). Smoking by Vietnamese women is considered to be inappropriate and associated with “loose morals” (26). Although others reported a slight increase (0.3 percentage points/year) in prevalence among Vietnamese women from 2001 to 2009, cohort-specific estimates were not presented and the data were derived using different sampling strategies (17). Our results are consistent with declining prevalence reported in successive cohorts of Thai women (16), but not with increasing prevalence in successive cohorts of Japanese women (18, 19) that fits better the developing country pattern (23).

Whilst we could not isolate effects specific to period from those specific to cohort, our age-period-cohort analysis suggested that changes commencing in the early-1990s may have been responsible for declining prevalence in the post-1960s cohorts of Vietnamese men. Members of those cohorts would have commenced smoking in the 1990s, and the inverse association (27) between smoking prevalence and years of education in this study was stronger among those who commenced smoking in those years. The timing of these period effects, if that is what they are, coincided with local and international tobacco initiatives. In Vietnam, the first restrictions on smoking in designated buildings and public places were implemented in 1989, and these were followed by other initiatives during the early 1990s that included bans on advertising, promotion and sponsorship, and increases in tobacco taxes (28, 29). The success of similar anti-tobacco activities in Singapore (22), but implemented 20 years earlier, demonstrates that Asian smokers were responsive to these initiatives. Additionally, following the “Doi Moi” (Renovation) policy reforms initiated in 1986 and implemented from 1989, Vietnamese people have been increasingly employed within Vietnam by foreign-partnered corporations that have implemented workplace policies on tobacco. It is also possible that increased travel to countries such as Australia, Canada and the USA – where tobacco controls are in place – has also influenced behaviour. If so, better educated men may have been influenced by the emerging stigmatisation of tobacco smoking, because they were more likely to work in offices including those of local and international companies, to visit shopping centres and cinemas, to travel abroad to countries where smoking restrictions were implemented, and to have access to television and radio on which anti-tobacco programs were broadcast. Our findings support the hypothesis suggested by Lopez et al for the most recent cohorts of men that smokers would most likely be the persons with lower education levels (22).

The quantities of cigarettes smoked daily by Vietnamese smokers (around 10 per day as a median estimate) are lower than those reported by their Western counterparts [e.g. Australia (30), Poland, Turkey, and the USA (31)]. This is positive because the existence of a dose-relationship of tobacco smoking and chronic disease is widely accepted. Based on the equation of Doll and Peto (32), smoking 10 of the type of cigarettes consumed in the UK during the 1950s and 1960s, rather than 20 cigarettes/day, would result in a 62% reduction in risk of lung cancer for smokers aged 40–79 years who commenced smoking at ages 16–25 years. However, Vietnamese smokers are less likely to quit and relatively more of them reach the high levels of cumulative exposure of the heaviest smokers in developed countries [e.g. reference (33)]. This emphasises the importance of strengthening strategies to encourage smokers in Vietnam to quit smoking, and to assist them to do so by offering cessation advice integrated in primary health-care activities, counselling services, and low-cost pharmacological therapy (4). Whilst smoking prevalence is declining, the prevalence remains high and a low quit rate predisposes most of those who start smoking to premature mortality.

This study has several strengths and some limitations. The data were collected from a nationally-representative large sample of the Vietnamese population selected from comprehensive population listings. Whilst recruitment was achieved with high participation proportions for a survey involving overnight fasting, blood sampling and nearly two hours of on-site attendance, the possibility of non-participation bias cannot be discounted. Reassuringly, our estimated prevalence of current smoking among 25−64 year old men (57.7%) is identical to the estimated prevalence of current smoking among 25−64 year old men in the 2010 Global Adult Tobacco Survey of Vietnam (57.7%) (15). The GATS had a reported response proportion of 92.7%. Although smoking measurements were made by self-report, without objective verification, the interviews were conducted by trained staff in accord with standardised protocols designed specifically by WHO to minimise avoidable sources of random error and bias, and using a culturally-sensitive instrument that had been translated and back-translated. Additionally, the validity of self-reported population-based data on current smoking in other populations has been confirmed from measured serum nicotine levels (34).

Whilst we were unable to distinguish between period and cohort effects, our modelling demonstrated the possibility of period effects that were consistent with other results about the timing of effects. Our data were not derived from longitudinal observations on smokers, but a previous study has shown that estimates of smoking prevalence from reconstructed cohort analyses are similar to the contemporaneous estimates of smoking prevalence derived from repeated cross-sectional data (35). Differential mortality is another potential source of bias in all analyses of this type, but the corrections we made based on a life table for Vietnamese population and an assumed increase in risk for smokers derived from findings for a similar population (11) suggest that the bias if any was relatively minor. Finally, despite a small proportion of female smokers, the large sample size allowed us to conduct analyses of trends and cohort patterns in prevalence of smoking among women.

3.6 Conclusions

In conclusion, this analysis shows that the proportion of current daily smokers has declined in more recent cohorts of adult men, and has dropped consistently among successive cohorts of women. Local and global tobacco control initiatives commencing in the 1990s have coincided in timing with the changes observed. Despite smoking only moderate number of cigarettes per day, Vietnamese smokers tend not to quit and thus eventually accumulate high level of exposures. These findings suggest that public health action to prevent smoking uptake is succeeding, but that efforts to encourage cessation among current users need to be strengthened.

3.7 Postscript

The results of this chapter show that tobacco smoking has declined in recent birth cohorts of men and successive cohorts of women, and the decrease for men coincided with the introduction of tobacco control initiatives. Harmful use of alcohol is another important modifiable risk factor for NCDs. In the following chapter, data on alcohol use additional to that in Chapter 2 will be presented, and the construct and predictive validity of the measurements will be assessed.

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Appendix 3.A. Additional data analysis

To estimate trends in smoking prevalence, smoking status of each subject in each year of life (and at each age) was determined from the reported age of onset of smoking and, for quitters, the reported age of quitting. The annual observations were then categorised into 5-year age groups (age) and 5-year year of birth groups (cohort), with the mid-point of each span as its assigned value, and year (period) was calculated as period = cohort + age. Correction for differential mortality of smokers and never-smokers (1, 2) was made using the official life table for Vietnam in 2009 published by the General Statistics Office (3). A 30% increased risk of mortality for current smokers relative to never-smokers was assumed. This estimate is taken from a prospective cohort study conducted in Taiwan, a country with similar sex-specific smoking prevalence as Vietnam (4). Smokers were assumed to attain this increased risk after 10 years of smoking, and to bear a proportionately lower risk during earlier years of smoking. Risk was assumed to reduce each year after quitting smoking and to return to the risk of never-smokers after 20 years (5, 6). The observations were reduced to one observation for each age, period, and cohort in each category of smoking status, with sampling weights summed to represent the numbers of persons in each category of smoking status in each age-cohort-period grouping of the population. Figure 3.2 was produced by estimating prevalence from ratios of the sums of sampling weights for each smoking status category to their overall total. The contribution of age, period and cohort were estimated by binary regression of smoking status indicators on binary (0/1) covariates for each age, period and cohort group. Tests of trend were conducted by replacing the binary terms for period or cohort with a single linear covariate (its centred value). Tests of quadratic trend were conducted by adding to the model a covariate taking the value of the square of the centred linear covariate. Turning points in quadratic models were estimated from the first derivative of the regression equation. To test the robustness of findings to assumptions about latency periods and elevation in risk of smokers, the analyses were repeated with a range of latency periods (5, 15 and 20 years in place of 10 years) and relative risks (1.2, 1.5 and 2.0 in place of 1.3).

To estimate the effects of education on smoking trends, log binomial regression (7) was used to estimate the probability of ever being a smoker, and log multinomial regression (8) was used to estimate the probability of each category of smoker (non-daily smoker, former daily smoker and current daily smoker). The covariates were binary (0/1) covariates for year of birth after a cut-point, years of education entered as a continuous predictor, and interaction terms formed as the product of the binary terms for year of birth and the covariate for years of education. Assessment of statistical interaction was conducted using Wald tests. Excluding the most recent birth cohort (year of birth 1980–84) from these analyses, on the grounds that members of this cohort had not had full opportunity to complete their education, made little difference to the results. Analyses based on educational levels obtained (less than primary, primary, junior secondary, senior secondary and college/undergraduate or postgraduate) produced similar results.

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Appendix 3.B. Additional Table

Additional Table 3.B. Weighted median (IQR) of smoking characteristics at different ages by sex

		No cigarettes/day	Duration (years)	Pack-years
Sex	Age	Median(IQR)	Median(IQR)	Median (IQR)
Men				
	30 years	10.0 (7.0,20.0)	11.0 (8.0,13.0)	6.0 (2.5,10.0)
	40 years	10.0 (7.0,20.0)	20.0 (17.0,22.0)	11.0 (6.0,20.0)
	50 years	10.0 (8.0,20.0)	30.0 (25.0,32.0)	16.0 (9.0,29.0)
	60 years	10.0 (8.0,20.0)	39.0 (32.0,42.0)	21.0 (11.5,36.0)
Women				
	30 years	5.0 (4.0,10.0)	10.0 (0.0,12.0)	2.5 (0.3, 6.0)
	40 years	5.0 (4.0,10.0)	20.0 (10.0,23.0)	5.0 (2.3,11.0)
	50 years	5.0 (3.0,10.0)	28.0 (18.0,32.0)	7.0 (3.3,12.6)
	60 years	5.0 (3.0,15.0)	39.0 (16.0,42.0)	9.3 (3.2,29.3)

Chapter 4. Alcohol consumption in Vietnam, and the use of 'standard drinks' to measure alcohol intake

4.1 Preface

Alcohol use, modifiable lifestyle behavioural risk factor, accounts for a large proportion of the burden of disease, but nationally-representative data on alcohol use in Vietnam are limited. Estimated levels and prevalence of hazardous/harmful use of alcohol are presented in this chapter. In addition, an assessment of the validity of measurements of alcohol intake in units of standard drinks is presented. The contents of this chapter have been published in *Alcohol and Alcoholism (1).*

4.2 Introduction

Harmful alcohol use was the fifth leading contributor to the global burden of disease behind tobacco smoking and hypertension in 2010 (2). Given this burden, systematic population-based surveillance of alcohol intake is essential for quantifying harmful use and trends in use (3, 4). National data collections on alcohol production, trade and retail sales provide useful information but, particularly in countries where home-made alcohol is common, population-based surveys are needed to provide a comprehensive assessment of alcohol intake.

Data collected on alcohol consumption in such surveys are usually by self-report of the frequency of drinking occasions, and the quantity of alcohol consumed on each occasion. The quantity of alcohol consumed on each occasion is often represented in terms of a 'standard drink' – the serving size of each type of alcohol that provides a particular number of grams of ethanol. This provides comparability and standardises the assessment across alcohol types, brands and individual preferences. Visual aids like glasses and bottles, or photographs of them, that illustrate the actual serving size providing a particular amount of alcohol are recommended to assist respondents to estimate their standard drink consumption (5). However, evidence suggests that drinkers in urbanised countries are unable to accurately judge the size of their drinks (6, 7). This may be even more problematic in developing countries such as Vietnam where alcohol is often ‘home-made’ and the serving sizes vary, making this estimation more difficult.

Whilst the types of alcohol available in the large cities of Vietnam and the methods of serving them reflect a modern Western-style lifestyle, 70% of the population lives in rural areas (8). The rural practice is to purchase spirits made by small-scale local producers from rice, maize, potato or fruits (9). The alcohol concentration of these products can vary from 29.5% to 45% (10). The alcohol is drunk from small cups of varying sizes, meaning the alcohol content of each serve varies throughout the country. The concept of a standard drink appears not well-suited to Vietnam, but no studies have assessed this issue. Indeed, alcohol use has been studied in Vietnam only in respect of its socioeconomic and psychosocial determinants (11-15).

The first objective of this study was to provide nationally-representative data on alcohol consumption patterns in Vietnam. The second objective was to assess the accuracy and value of this information. Because self-reported quantity of alcohol consumption is positively associated with blood pressure (16), and the average volume of alcohol consumed is more likely to play a role in the risk of raised blood pressure than the frequency of drinking (17), we used blood pressure as an outcome to test its predictive validity. In so doing, we subjected the underlying assumption – that standard drinks are understandable to survey respondents – to a field test: would responses by Vietnamese people in rural areas (where home-made products are widely consumed) have evidence of validity?

4.3 Methods

4.3.1 Study participants

Participants were from a nationally-representative population-based survey of NCD risk factors in Vietnam conducted during 2009−2010 using the WHO STEPS method (18), with the methods elsewhere (19). In brief, participants aged 25–64 years were selected by age- and sex-stratified random sampling from clusters. These clusters were selected with probability proportional to population size with replacement from strata of economic (rich/poor) and residential (urban/rural) classification. The final sample consisted of 14,706 participants recruited with a response proportion of 64.1% (14,706/22,940). The protocol of this survey was approved by the Ethics Committee of Vietnam Ministry of Health and the Tasmanian Health and Medical Human Research Ethics Committee, and informed consent was obtained from participants before collecting data.

4.3.2 Blood pressure and covariates

The STEPS questionnaire (18) was used to collect information on age, residential status (urban and rural), ethnicity (Kinh majority group, and non-Kinh minority groups including Khmer, Tay, Thai, and Chinese), years spent at school, monthly household income per adult member, tobacco smoking, alcohol intake, and fruit and vegetable consumption. The questionnaire was translated into Vietnamese and back-translated to ensure the appropriate meaning of each item was retained, and visual aids (show cards) with locally relevant examples were used for questions on alcohol and fruit and vegetable consumption. Pathophysiological measurements including weight, height, waist circumference, hip circumference, and blood pressure (BP) were made according to the standardised STEPS procedures (18). Blood pressure (at the midpoint of the right upper arm) was measured by trained staff using an Omron HEM 907 digital automatic blood pressure monitor. For each participant, three measurements in sitting position were recorded, the first after 15 minute rest and subsequent readings after 2 minute intervals. Hypertension was defined as systolic BP (SBP) ≥140 mmHg and/or diastolic BP (DBP) ≥90 mmHg, or using medication for hypertension.

4.3.3 Self-reported alcohol consumption

Face-to-face interviews were performed by trained interviewers. Information on alcohol consumption during 12 months (frequency and quantity), 4 weeks (binary responses to question on whether or not alcohol had been consumed only) and one week (frequency and quantity) prior to the interview was gathered. Show cards (see Appendix 8) illustrating a standard drink (equivalent to 10 grams of ethanol) of typical sizes and strengths of common beverages were used to prompt reporting of alcoholic drinks usually consumed on each occasion, particularly for home-made products.

Subjects who reported never consuming alcohol were classified as non-drinkers, as were those who reported not drinking alcohol during the last year. Those who reported consuming at least one alcoholic beverage during the previous year were asked about their frequency of consumption (response categories ≤1 day/month, 1–3 days/month, 1–4 days/week, 5–6 days/week, and daily). For presentation of results, the responses were categorised as ≤2, 2.1−3, 3.1−6, and >6 standard drinks. This provided a distribution of responses similar to that of frequency, thereby facilitating comparison. Hazardous drinking was defined as consuming 4−6 standard drinks (men) or 2−4 standard drinks (women) on average per day during the last year, while harmful drinking was defined as consuming at least 6 standard drinks (men) or 4 standard drinks (women) (18). The frequency of consumption (the midpoint of each category scaled in terms of number of days per week) was multiplied by the number of standard drinks per occasion to calculate the average weekly intake (frequency × quantity) categorised as none, ≤1, 1.1−7, 7.1−14, and >14 drink(s)/week.

The quantities consumed on a drinking occasion during the previous week were classified in the same way as quantities consumed on a previous occasion during the previous year. Frequency of consumption during the previous week was grouped as none, 1, 2, 3–4, 5–6, or 7 days that week. This provided a distribution of responses similar to that for frequency during the past year, also assisting comparison. Binge drinking was defined as consuming at least 5 standard drinks (men) or 4 standard drinks (women) on at least one drinking occasion during the last week (18).

4.3.4 Data analysis

Linear regression was used to estimate adjusted means of SBP and DBP, and Poisson regression with robust standard errors (20) was used to estimate prevalence and ratios of prevalence of hypertension at levels of alcohol intake. Those using medication for hypertension were excluded from the linear regression analysis. Confounders including age, education levels, ethnicity, smoking status (urban areas), number of daily servings of fruit and vegetables, and waist circumference were adjusted for in each analysis. Tests of trend were undertaken by replacing multiple binary (0/1) covariates for alcohol consumption with a single ordinal covariate. Agreement and ranking stability between reported quantities of alcohol intake were assessed from differences in means, the unweighted Kappa statistic (21) and Pearson correlation coefficients. Model calibration was assessed by R-squared values (linear regression) and deviance (Poisson regression), and subject discrimination was assessed using the Youden Index (22). Improvements in calibration and discrimination were measured as changes in these indices. For a binary classification, the change in the Youden Index is equal to the net reclassification index and twice the change in area under the curve (22). All analyses were conducted separately for men and women, and for men from urban and rural areas, using software for complex survey analyses provided by Stata version 12.0.

4.4 Results

Selected characteristics of study subjects, stratified by sex and urban/rural classification of area of residence, are presented in Table 4.1. Approximately 65% of the participants, who were aged 25–64 years, lived in rural areas, and these subjects had lower proportions of high school completions and lower mean household income per adult family member compared to urban people. Men had higher mean levels of blood pressure than women, and greater proportions of hypertensive individuals, but urban/rural differences were slight.

Table 4.1 shows that more than 80% of men had consumed alcohol during the last year and that almost 40% had consumed alcohol in the quantities considered hazardous or harmful to their health. Around two-thirds (slightly more in rural areas than urban areas) had consumed alcohol during the last month, and 59.8% (53.4% of urban men and 62.5% of rural men) had done so during the last week. The men had consumed alcohol on average on 1.8 days − the drinkers among them on 2.5 days (urban men 2.3, rural men 2.6) − during that week. Male drinkers had consumed 4.5 drinks (urban men 4.3, rural men 4.6) on average on each drinking occasions. One-in-four men were classified as binge drinkers. Less than 5% of the women had consumed alcohol in the past week, and only 11.8% had ever consumed alcohol.

Table 4.1. Characteristics of subjects

	Men		Women	
Characteristic	Urban	Rural	Urban	Rural
Age: mean(SD)	40.6(10.3)	40.5(10.2)	41.1(10.4)	41.2(10.6)
Minority ethnicity	4.4%(110/2359)	6.5%(1051/4428)	4.2%(142/2815)	6.0%(1141/5074)
Education completed				
Less than primary	8.3%(206/2362)	17.9%(842/4423)	13.7%(500/2813)	28.2%(1668/5072)
Primary	18.5%(425/2362)	30.9%(1405/4423)	20.2%(558/2813)	29.8%(1546/5072)
Secondary	23.4%(593/2362)	31.2%(1458/4423)	23.3%(650/2813)	26.2%(1291/5072)
Senior secondary	20.7%(517/2362)	11.6%(426/4423)	20.9%(537/2813)	8.9%(313/5072)
College/University+	29.1%(621/2362)	8.4%(292/4423)	21.9%(568/2813)	6.9%(254/5072)
Income: mean(SD)*	112.6(148.4)	62.8(73.9)	102.1(102.6)	59.3(64.8)
Smoking status				
Never	29.1%(643/2360)	23.4%(1080/4422)	97.4%(2728/2815)	97.4%(4823/5071)
Former	17.5%(490/2360)	17.0%(857/4422)	1.1%(32/2815)	0.8%(69/5071)
Current	53.4%(1227/2360)	59.5%(2485/4422)	1.5%(55/2815)	1.8%(179/5071)
Diet: mean(SD)†	3.2(2.1)	3.1(2.0)	3.5(2.0)	3.1(1.9)
Body size and fatness				
BMI: mean(SD)	22.3(3.3)	21.2(2.9)	22.0(3.1)	21.3(3.0)
Waist: mean(SD)	78.0(9.3)	73.6(8.5)	74.1(8.4)	71.1(8.5)
WHR: mean(SD)	0.9(0.1)	0.8(0.1)	0.8(0.1)	0.8(0.1)
Blood pressure (mmHg)				
Systolic: mean(SD)	124.6(17.2)	125.0(17.2)	115.7(18.4)	116.8(17.2)
Diastolic: mean(SD)	75.9(12.4)	75.7(12.0)	70.9(11.9)	71.2(11.2)
Raised blood pressure	18.9%(610/2370)	19.6%(1168/4434)	12.9%(523/2823)	10.8%(796/5079)
Ever-consumed alcohol				
Yes	82.5%(1941/2368)	85.1%(3760/4434)	15.9%(430/2818)	10.0%(621/5078)
Last year consumption				
Yes	78.5%(1831/2368)	81.2%(3555/4434)	13.5%(365/2818)	7.9%(513/5078)
Frequency of drinking				
None	21.3%(528/2351)	18.6%(869/4400)	86.6%(2450/2814)	92.2%(4563/5075)
<1/month	16.1%(336/2351)	11.6%(477/4400)	8.3%(222/2814)	3.9%(254/5075)
1−3 days/month	24.6%(523/2351)	26.6%(1161/4400)	3.2%(87/2814)	2.2%(145/5075)
1−4 days/week	22.9%(530/2351)	23.4%(1015/4400)	1.6%(42/2814)	1.0%(58/5075)
5−6 days/week	4.2%(98/2351)	4.0%(213/4400)	0.0%(1/2814)	0.1%(18/5075)
daily	10.9%(336/2351)	15.7%(665/4400)	0.2%(12/2814)	0.6%(37/5075)
Quantity per occasion‡				
Standard drinks	4.3(3.3)	4.6(3.7)	1.6(1.3)	1.7(2.0)
Alcohol intake status§				
Low	59.8%(1509/2370)	59.1%(2638/4434)	96.2%(2727/2823)	97.9%(4916/5079)
Hazardous	20.9%(436/2370)	14.8%(668/4434)	2.6%(69/2823)	1.4%(120/5079)
Harmful	19.3%(425/2370)	26.1%(1128/4434)	1.2%(27/2823)	0.7%(43/5079)
Last month consumption				
Yes	65.2%(1523/2368)	71.4%(3069/4434)	6.9%(203/2818)	5.0%(314/5078)

Last week consumption				
Yes	53.4%(1284/2368)	62.5%(2709/4434)	4.5%(136/2818)	3.3%(221/5078)
Frequency of drinking				
Days: mean(SD)	2.3(2.4)	2.6(2.5)	1.2(1.5)	1.9(2.3)
Quantity per occasion‡				
Standard drinks	4.3(3.1)	4.6(3.6)	2.3(2.5)	1.7(1.6)
Binge drinking¶	22.0%(488/2368)	26.5%(1083/4434)	0.9%(20/2818)	0.5%(30/5078)

* Monthly household income per adult member ($US).

† Number of fruit and vegetable serving per day.

‡ Number of standard drinks consumed per occasion when drinking alcohol.

§ Hazardous drinking: ≥4 standard drinks (men) and ≥2 standard drinks (women) per drinking occasion during the last year, harmful drinking: ≥6 standard drinks (men) and ≥4 standard drinks (women) per drinking occasion during the last year.

¶ ≥5 standard drinks (men) and ≥4 standard drinks (women) per drinking occasion during the last week.

Figure 4.1 summarises the distribution of standard drinks by the reported frequency of drinking occasions during the last year. It shows a generally increasing median number of standard drinks with increasing number of reported drinking occasions, but with the exception of the daily category and with a wide distribution of standard drinks in each frequency category. In consequence, the number of drinking occasions last year was only moderately correlated with the number of standard drinks consumed per occasion for both men (urban r=0.26, rural r=0.22) and women (urban r=0.46, rural r=0.43). The number of standard drinks consumed on each drinking occasion in the past year was highly correlated with standard drinks consumed per occasion in the last week among men (urban r=0.76, rural r=0.80) and women (urban r=0.82, rural r=0.89). With the zero responses of non-drinkers on each occasion included, and the quantities categorized as in Table 4.2 and 4.3, the unweighted kappa statistics were similarly a little higher in rural areas for both men (urban κ=0.51, rural κ=0.56) and women (urban κ=0.49, rural κ=0.52). Mean weekly intake in numbers of standard drinks by men who drank alcohol during the last year was greater when calculated from information on last year consumption [urban 10.0(SD 15.3), rural 12.0 (SD 18.5)] than when calculated from information on last week consumption [urban 7.6(SD 12.2), rural 10.0(SD 16.8)]. For women who drank alcohol during the last year, mean weekly intake in numbers of standard drinks when calculated from last year information [urban 1.3(SD 3.7), rural 2.7 (SD 6.7)] was similar to that calculated from last week information [urban 1.6(SD 5.1), rural 2.1(SD 5.3)].

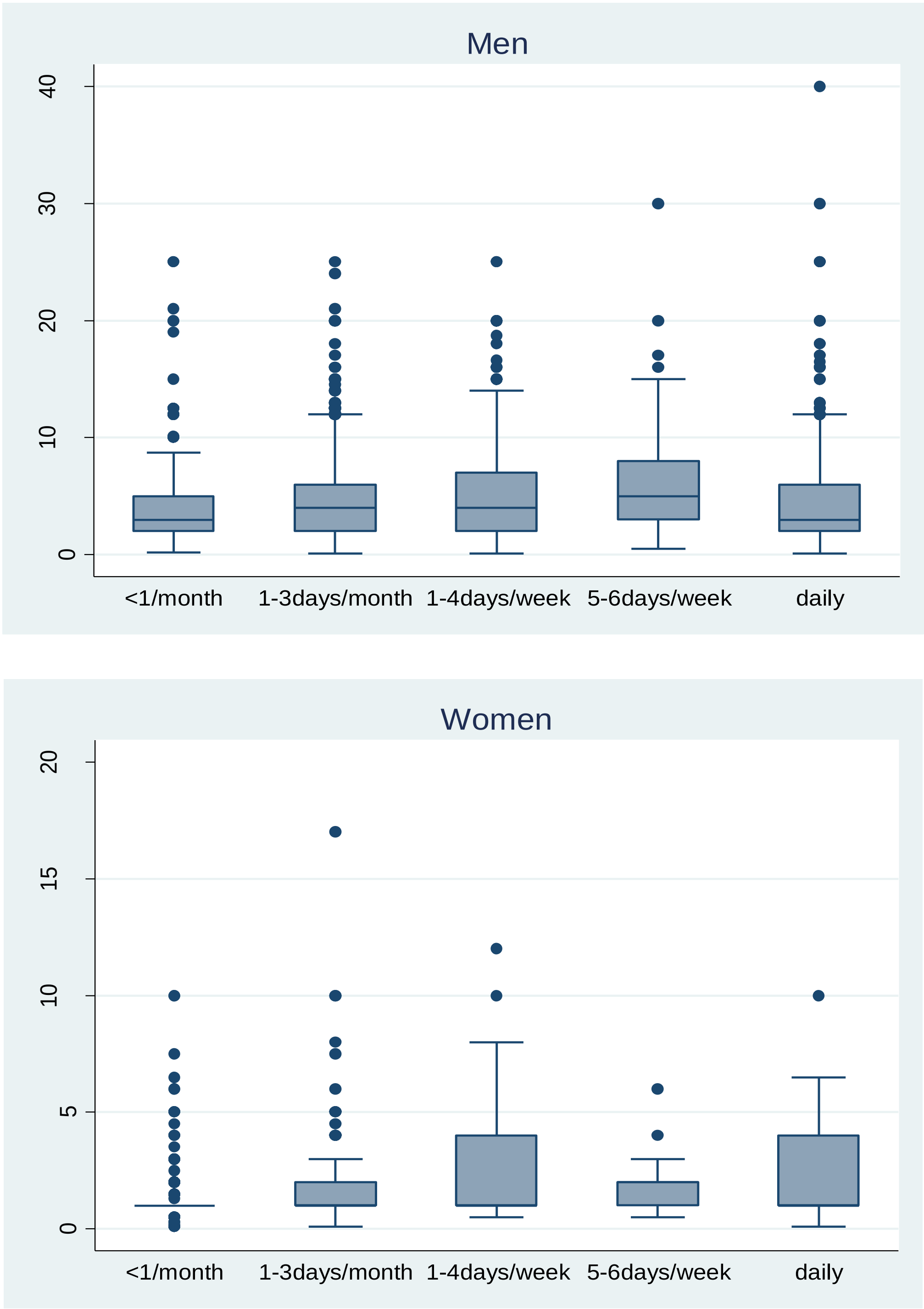

Figure 4.1. Boxplots of quantity of standard drinks consumed by the frequency of consuming alcohol among men (top) and women (bottom)

Reported numbers of standard drinks consumed on each drinking occasion in the last year was weakly but significantly correlated with levels of education completed (men $r=-0.12$, women $r=-0.10$) and higher for current smokers [men: mean(SD)=4.9(3.7), women: mean(SD)=3.5(2.5)] than for former or never smokers [men: mean(SD)=4.1(3.3), women: mean(SD)=1.5(1.5)]. There were similar findings for quantities consumed on each drinking occasion during the last week. For both men and women, the associations were generally stronger in rural areas irrespective of reference period (data not shown).

Estimated associations of alternative measures of alcohol consumption with BP and with hypertension are presented in Table 4.2 and Table 4.3 respectively for men. Those who reported having consumed alcohol during the last year had mean BP that was greater by about 5 mmHg (SBP) or 3–4 mmHg (DBP), and with prevalence of hypertension greater by around 7 percentage points in rural areas, than those who had not. Compared with non-drinkers, the three measures (frequency, quantity, and total intake) of alcohol consumption during the last year provide similar associations with BP ($p<0.001$ for trend in each case). For last week consumption, the increases in mean BP with alcohol consumption were similarly dose-related but a little smaller in magnitude. Particularly for urban respondents, the associations with hypertension also were stronger for last year consumption than for last week consumption (Table 4.3). The increase in risk of hypertension was confined mostly to the heaviest drinkers in urban areas, but commenced with the lightest drinkers in rural areas and with successive increases in risk across categories ($p<0.001$ for trend). Adjustment for BMI or waist-to-hip ratio instead of waist circumference produced similar results. The generally weaker associations of these alternative alcohol measures with BP and hypertension among women are shown in the Additional Table 4.A.1. For women, the lowest prevalence of hypertension occurred among those with light-to-moderate consumption.

In analyses of data for men, frequency of drinking occasions and quantity per occasion were not independent predictors of BP and hypertension. Across all outcomes (SBP, DBP, hypertension), urban/rural location and reference periods (last year, last week), including linear covariates for both frequency and quantity in the regression models greatly reduced the estimated coefficients of each vis-à-vis their values in models without inclusion of the other. Results were similar when total intake (frequency × quantity) was used in place of quantity. An exception was last week consumption by urban men, for whom total intake was independent of frequency.

Table 4.2. Association between alcohol consumption and mean systolic and diastolic blood pressure by residential area among men

	Urban men		Rural men	
	Systolic*	Diastolic*	Systolic†	Diastolic†
	Mean(95%CI)	Mean(95%CI)	Mean(95%CI)	Mean(95%CI)
Last year consumption				
None	120.0(118.2,121.8)	72.6(71.3,74.0)	120.5(118.9,122.1)	73.2(72.0,74.3)
Any	124.9(123.9,125.8)	76.2(75.5,76.9)	125.7(124.9,126.5)	76.1(75.5,76.7)
Difference	p<0.001	p<0.001	p<0.001	p<0.001
Frequency of drinking				
None	119.9(118.0,121.7)	72.6(71.2,73.9)	120.3(118.7,121.9)	72.8(71.7,73.9)
<1/month	122.9(120.8,125.1)	75.0(73.3,76.7)	123.0(120.8,125.2)	73.6(72.0,75.3)
1−3 days/month	124.4(122.4,126.3)	75.8(74.3,77.3)	124.7(123.4,125.9)	75.5(74.6,76.4)
1−4 days/week	125.6(124.1,127.1)	76.4(75.3,77.5)	126.3(124.8,127.8)	76.4(75.3,77.5)
5−6 days/week daily	126.7(124.9,128.4)	78.0(76.6,79.3)	128.0(126.3,129.8)	78.0(76.8,79.3)
Linear trend	p<0.001	p<0.001	p<0.001	p<0.001
Quantity per occasion‡				
None	119.9(118.1,121.7)	72.6(71.2,74.0)	120.3(118.7,121.8)	72.8(71.7,73.9)
<2 drinks/occasion	123.7(121.8,125.5)	75.1(73.6,76.6)	123.5(121.3,125.7)	74.3(72.7,75.9)
2−3 drinks/occasion	124.0(122.5,125.6)	75.6(74.5,76.7)	124.7(123.4,126.1)	75.8(74.8,76.8)
3.1−6 drinks/occasion	125.2(123.6,126.9)	76.6(75.3,77.9)	126.4(124.9,127.9)	77.1(76.0,78.3)
>6 drinks/occasion	126.7(124.5,129.0)	77.6(75.9,79.4)	127.6(125.9,129.3)	76.5(75.4,77.6)
Linear trend	p<0.001	p<0.001	p<0.001	p<0.001
Weekly intake§				
None	119.8(118.0,121.7)	72.5(71.1,73.9)	120.3(118.7,121.8)	72.8(71.7,73.9)
≤1 drink/week	122.1(120.4,123.8)	74.3(73.0,75.5)	123.7(122.2,125.3)	74.5(73.3,75.6)
1.1−7 drinks/week	126.0(124.1,127.9)	77.1(75.6,78.5)	124.6(123.3,125.9)	75.4(74.4,76.4)
7.1−14 drinks/week	125.9(124.0,127.8)	76.3(75.0,77.7)	126.9(124.6,129.2)	77.3(75.7,78.8)
>14 drinks/week	126.1(124.4,127.8)	77.4(76.0,78.7)	128.4(126.9,130.0)	77.9(76.8,79.0)
Linear trend	p<0.001	p<0.001	p<0.001	p<0.001
Last month consumption				
None	121.2(119.9,122.6)	73.5(72.5,74.6)	121.2(119.9,122.5)	73.2(72.3,74.0)
Any	125.2(124.2,126.2)	76.5(75.7,77.2)	126.1(125.2,126.9)	76.5(75.9,77.1)
Difference	p<0.001	p<0.001	p<0.001	p<0.001
Last week consumption				
None	121.7(120.4,122.9)	73.7(72.8,74.6)	121.5(120.3,122.6)	73.3(72.5,74.1)
Any	125.7(124.6,126.8)	77.0(76.1,77.8)	126.6(125.6,127.5)	76.8(76.2,77.5)
Difference	p<0.001	p<0.001	p<0.001	p<0.001
Frequency of drinking				
None	121.6(120.4,122.9)	73.7(72.8,74.6)	121.5(120.3,122.6)	73.3(72.5,74.1)
1 day	125.2(123.4,127.1)	76.6(75.2,78.0)	125.2(123.9,126.5)	75.6(74.6,76.6)
2 days	126.1(123.9,128.4)	76.5(74.6,78.4)	126.6(124.3,128.9)	77.3(75.6,78.9)
3−4 days	125.3(122.9,127.8)	77.4(75.6,79.2)	128.3(125.5,131.1)	77.9(75.6,80.2)
5+ days	126.6(124.9,128.4)	77.9(76.6,79.1)	128.0(126.1,130.0)	78.2(76.9,79.6)
Linear trend	p<0.001	p<0.001	p<0.001	p<0.001

Quantity per occasion‡				
None	121.6(120.4,122.9)	73.7(72.8,74.6)	121.5(120.3,122.6)	73.3(72.5,74.1)
<2 drinks/occasion	123.3(121.1,125.6)	75.3(73.6,76.9)	125.2(122.8,127.5)	75.2(73.6,76.9)
2−3 drinks/occasion	125.0(123.2,126.7)	76.3(75.0,77.6)	126.8(125.0,128.6)	77.7(76.4,79.0)
3.1−6 drinks/occasion	126.6(124.6,128.7)	77.8(76.1,79.4)	126.7(125.1,128.3)	76.9(75.6,78.2)
>6 drinks/occasion	127.4(124.8,130.0)	78.1(76.1,80.1)	127.3(125.5,129.1)	77.1(75.9,78.4)
Linear trend	p<0.001	p<0.001	p<0.001	p<0.001
Weekly intake§				
None	121.6(120.4,122.9)	73.7(72.8,74.6)	121.5(120.3,122.6)	73.3(72.5,74.1)
≤1 drink/week	120.3(116.8,123.8)	73.2(70.7,75.7)	121.6(118.1,125.2)	72.2(69.5,74.9)
1.1−7 drinks/week	125.7(124.0,127.5)	76.9(75.5,78.2)	126.6(125.3,127.9)	76.7(75.7,77.6)
7.1−14 drinks/week	126.8(124.5,129.2)	77.2(75.4,79.0)	125.6(123.8,127.5)	76.7(75.4,78.0)
>14 drinks/week	126.2(124.4,128.0)	78.1(76.7,79.4)	128.6(126.6,130.7)	78.4(76.9,80.0)
Linear trend	p<0.001	p<0.001	p<0.001	p<0.001

* Adjusted for age, education, ethnicity, servings of fruit and vegetable per day, smoking and waist circumference.

† Adjusted for age, education, ethnicity, servings of fruit and vegetable per day, and waist circumference.

‡ Number of standard drinks consumed per occasion when drinking alcohol.

§ Frequency × quantity.

Table 4.3. Association between alcohol consumption and raised blood pressure by residential area among men

	Urban men		Rural men	
	% n/N	PR(95%CI)*	% n/N	PR(95%CI)†
Last year consumption				
None	18.3%(138/537)	1.00	13.9%(196/879)	1.00
Any	19.0%(472/1831)	1.13(0.87,1.45)	20.9%(972/3555)	1.61(1.25,2.06)
Log difference		p=0.362		p<0.001
Frequency of drinking				
None	18.6%(137/528)	1.00	12.8%(192/869)	1.00
<1/month	18.7%(90/336)	1.06(0.74,1.52)	16.3%(117/477)	1.35(0.96,1.89)
1−3 days/month	17.1%(121/523)	1.06(0.76,1.46)	16.7%(267/1161)	1.54(1.16,2.04)
1−4 days/week	16.8%(125/530)	1.04(0.76,1.42)	22.1%(286/1015)	2.06(1.55,2.73)
5−6 days/week	25.5%(32/98)	1.33(1.00,1.78)	17.2%(64/213)	2.06(1.57,2.70)
daily	26.1%(102/336)		30.7%(233/665)	
Log linear trend		p=0.102		p<0.001
Quantity per occasion‡				
None	18.6%(137/528)	1.00	12.8%(192/869)	1.00
<2 drinks/occasion	19.6%(97/344)	0.97(0.71,1.32)	19.4%(169/615)	1.50(1.07,2.10)
2−3 drinks/occasion	17.4%(142/612)	1.02(0.74,1.40)	19.4%(294/1117)	1.69(1.28,2.23)
3.1−6 drinks/occasion	18.9%(152/595)	1.17(0.86,1.59)	20.9%(297/1066)	1.87(1.42,2.46)
>6 drinks/occasion	21.5%(78/273)	1.42(1.02,1.98)	24.0%(206/737)	2.05(1.55,2.72)
Log linear trend		p=0.047		p<0.001
Weekly intake§				
None	18.6%(137/528)	1.00	12.8%(192/869)	1.00
≤1 drink/week	17.0%(128/516)	0.94(0.68,1.30)	16.5%(202/854)	1.43(1.07,1.90)
1.1−7 drinks/week	19.4%(137/549)	1.21(0.89,1.65)	18.9%(297/1176)	1.68(1.27,2.21)
7.1−14 drinks/week	20.0%(90/328)	1.14(0.82,1.58)	24.7%(167/533)	2.06(1.48,2.88)
>14 drinks/week	19.9%(113/428)	1.23(0.90,1.68)	25.4%(295/951)	2.13(1.63,2.77)
Log linear trend		p=0.072		p<0.001
Last month consumption				
None	18.3%(214/845)	1.00	14.2%(310/1365)	1.00
Any	19.2%(396/1523)	1.13(0.92,1.40)	21.7%(858/3069)	1.66(1.35,2.05)
Log difference		p=0.246		p<0.001
Last week consumption				
None	17.2%(264/1084)	1.00	14.5%(385/1725)	1.00
Any	20.3%(346/1284)	1.27(1.04,1.55)	22.6%(783/2709)	1.63(1.34,1.99)
Log difference		p=0.019		p<0.001
Frequency of drinking				
None	17.2%(264/1084)	1.00	14.5%(385/1725)	1.00
1 day	20.1%(136/536)	1.32(1.03,1.70)	18.2%(284/1130)	1.43(1.12,1.81)
2 days	18.0%(51/191)	1.27(0.90,1.79)	23.6%(122/433)	1.82(1.31,2.54)
3−4 days	16.5%(42/171)	1.04(0.72,1.52)	27.4%(117/368)	2.06(1.49,2.86)
5+ days	24.7%(117/386)	1.29(1.01,1.65)	27.2%(260/778)	1.66(1.30,2.13)
Log linear trend		p=0.085		p<0.001

Quantity per occasion‡				
None	17.2%(264/1084)	1.00	14.5%(385/1725)	1.00
<2 drinks/occasion	21.6%(78/260)	1.06(0.80,1.42)	21.1%(147/525)	1.32(0.96,1.81)
2−3 drinks/occasion	19.2%(102/400)	1.18(0.91,1.52)	22.7%(235/775)	1.70(1.32,2.19)
3.1−6 drinks/occasion	21.3%(106/415)	1.42(1.06,1.90)	22.2%(247/870)	1.72(1.33,2.24)
>6 drinks/occasion	19.5%(60/209)	1.41(1.03,1.94)	24.3%(154/539)	1.72(1.32,2.23)
Log linear trend		p=0.004		p<0.001
Weekly intake§				
None	17.2%(264/1084)	1.00	14.5%(385/1725)	1.00
≤1 drink/week	15.8%(24/94)	0.86(0.57,1.30)	11.8%(39/165)	0.87(0.53,1.43)
1.1−7 drinks/week	20.5%(147/582)	1.32(1.02,1.70)	21.9%(341/1260)	1.63(1.29,2.05)
7.1−14 drinks/week	21.4%(84/271)	1.29(0.99,1.69)	23.3%(178/578)	1.76(1.33,2.32)
>14 drinks/week	20.4%(91/337)	1.29(0.98,1.71)	25.9%(225/706)	1.68(1.31,2.16)
Log linear trend		p=0.010		p<0.001

* Adjusted for age, education, ethnicity, servings of fruit and vegetable per day, smoking and waist circumference.

† Adjusted for age, education, ethnicity, servings of fruit and vegetable per day, and waist circumference.

‡ Number of standard drinks consumed per occasion when drinking alcohol.

§ Frequency × quantity.

As a more direct test of the utility of reported information on standard drinks, we investigated the contribution it made to model calibration and subject discrimination. Table 4.4 shows that for last year consumption and particularly for last week consumption, information on any consumption (versus none) provided the majority of improvement in model calibration and discrimination. Information on frequency of consumption provided a small further improvement in model calibration but not in discrimination. Information on quantity provided at best a minor additional improvement in calibration and discrimination. For both reference periods, the improvements in calibration were generally larger for models of rural respondents. It should be noted that all improvements in model calibration and discrimination due to additional information on frequency and quantity of consumption of alcohol were generally very small. This was particularly the case for women, for whom information on whether or not alcohol had been consumed last year provided almost all of any improvement in calibration or discrimination (Additional Table 4.A.2).

Table 4.4. Calibration of regression models using information on alcohol consumption and other covariates to estimate mean levels of systolic and diastolic blood pressure and the prevalence of hypertension among men, and discrimination between male subjects by model predictions

	Urban men						Rural men					
	Calibration*			Discrimination†			Calibration*			Discrimination†		
	Systolic	Diastolic	HTN‡	Systolic	Diastolic	HTN‡	Systolic	Diastolic	HTN‡	Systolic	Diastolic	HTN‡
Last year consumption												
Base model §	0.139	0.147	1223.1	0.189	0.231	0.314	0.122	0.153	2451.8	0.194	0.240	0.247
Improvement due to D_{LY}¶	+0.014	+0.014	–1.1	+0.021	+0.029	–0.005	+0.014	+0.009	–24.6	+0.022	+0.016	+0.001
Improvement due to F_{LY} ¶	+0.019	+0.021	–9.7	–0.004	+0.007	–0.008	+0.024	+0.023	–81.5	+0.019	+0.022	–0.013
Improvement due to Q_{LY} ¶	+0.017	+0.018	–11.7	+0.025	+0.025	–0.014	+0.021	+0.016	–72.5	+0.028	–0.010	+0.001
Improvement due to (F_{LY}×Q_{LY})	+0.023	+0.023	–12.7	+0.004	+0.014	–0.024	+0.026	+0.022	–84.8	+0.016	+0.003	–0.016
Last month consumption												
Base model §	0.139	0.147	1223.1	0.205	0.244	0.325	0.122	0.153	2451.8	0.219	0.246	0.249
Improvement due to D_{LM} **	+0.012	+0.013	–1.6	0.000	+0.013	–0.011	+0.017	+0.016	–38.7	+0.017	+0.008	+0.017
Last week consumption												
Base model §	0.139	0.147	1223.1	0.205	0.244	0.325	0.122	0.153	2451.8	0.219	0.246	0.249
Improvement due to D_{LW} ††	+0.014	+0.018	–5.9	+0.016	+0.012	–0.034	+0.021	+0.021	–42.0	+0.026	+0.022	+0.017
Improvement due to F_{LW} ††	+0.015	+0.019	–7.1	+0.017	+0.009	–0.040	+0.025	+0.027	–51.8	+0.007	–0.003	+0.010
Improvement due to Q_{LW} ††	+0.018	+0.021	–9.0	+0.028	–0.004	–0.015	+0.022	+0.024	–48.4	+0.029	+0.027	+0.015
Improvement due to (F_{LW}×Q_{LW})	+0.019	+0.022	–8.2	+0.021	+0.003	–0.024	+0.027	+0.029	–52.2	0.000	+0.022	+0.016

* Indices of calibration are R^2 (systolic and diastolic BP) or deviance (hypertension), with improvement measured by partial R^2 or change in deviance respectively.

† Index of discrimination is Youden Index (highest 20% of systolic and diastolic BP), with improvement measured by change in the Youden Index.

‡ HTN = hypertension defined as systolic BP ≥ 140 mmHg or diastolic BP ≥ 90 mmHg or taking medication for elevated BP.

§ Base model includes covariates for age, education, ethnicity, number of daily servings of fruit and vegetables, smoking and waist circumference.

¶ D_{LY} = whether or not the participant drank alcohol during the last year, F_{LY} = frequency of occasions of drinking alcohol during the last year, Q_{LY} = number of standard drinks consumed on each drinking occasion during the last year.

** D_{LM} = whether or not the participant drank alcohol during the last month.

†† D_{LW} = whether or not the participant drank alcohol during the last week, F_{LW} = frequency of occasions of drinking alcohol during the last week, Q_{LW} = number of standard drinks consumed on each drinking occasion during the last week.

4.5 Discussion

The key finding from these first nationally-representative data on alcohol consumption in Vietnam is that almost 40% of men were hazardous/harmful users and 25% were binge drinkers, whilst less than 5% women had consumed alcohol during the last week. The information on frequency of consumption and the number of standard drinks consumed had predictive accuracy for mean levels of BP and hypertension. Those consuming alcohol during the reference period had higher mean BP and risk of hypertension than those who had not. The increases were widened for the most frequent and heaviest drinkers, particularly for those from rural areas. However, most of the improvement in model calibration and subject discrimination were provided by binary responses to questions on whether or not alcohol had been consumed during the reference period.

The overall findings are broadly consistent with previous studies. Firstly, reflecting the cultural practice in Asian countries, alcohol use is much common among men than women (23). Secondly, the prevalence of ever and current drinkers was lower than that typically seen in Western countries (24). The estimated prevalence of male ever-drinkers was similar to that of previous local surveys in Vietnam using STEPS protocols (12, 25). The prevalence of alcohol use during the past 12 months was also comparable to that of a nationally-representative sample in China (26). Although the prevalence of binge drinking in the present study was lower than in previous surveys in Mozambique (40%) (27), our estimated prevalence among rural men in Can Tho (36.2%) is almost identical to the estimate in Can Tho survey whose participants were mainly from rural areas (25). Consistent with findings from China (26, 28), rural respondents in Vietnam had generally higher intake than urban respondents.

Our findings that alcohol consumption is positively related to BP and hypertension are consistent with previous studies in Asian (29-32) and Western countries (17, 31, 33, 34). For men, we found no evidence of a protective effect of low-to-moderate consumption that has been reported in a previous study (34), and which has prompted recommendations to limit alcohol consumption to ≤2 drinks per day in published guidelines on the primary prevention of hypertension (35, 36). For hypertension but not overall levels of BP, the increase in risk was largely restricted to the heaviest drinkers (those drinking alcohol at least five days per week, and drinking more than three standard drinks on each drinking occasion) in urban areas.

In rural areas, there appears to be a lower threshold for the effect of alcohol consumption on BP and hypertension, this may be because home-made products with strong alcohol content are more common there. Our results for women (see Additional Table 4.A.1) suggested a protective effect of light consumption for hypertension, and no increase in mean BP for light-to-moderate consumption (16, 37), but the numbers of female drinkers in these categories were small.

We found generally similar increases in mean levels of BP and in prevalence of hypertension irrespective of whether alcohol consumption was characterised as frequency of drinking occasions, number of standard drinks per drinking occasion, or total alcohol intake. Part of our purpose was to investigate whether respondents, and particularly rural respondents, in Vietnam would be able to provide valid information about quantities expressed in terms of standard drinks. Somewhat unexpectedly, we found that reported numbers of standard drinks on each drinking occasion, as well as total intake based on frequency and quantity, were strongly associated with mean BP and the risk of hypertension in rural areas. This suggests that the concept of a standard drink was understandable for rural respondents, particularly when illustrated (as we did) with the use of visual aids depicting serving sizes for a range of alcohol drinks including spirits. The cups used to drink home-made wine in rural areas, and the alcoholic content of the home-made product drunk from them, vary somewhat according to local custom but it appears that respondents were able to convert them reasonably well to the serving sizes used to illustrate a standard drink of spirits in the visual aids. For urban respondents, the wider range of alcohol types and serving sizes may make reporting of alcohol consumption a more complex task.

There was some evidence that our estimates of quantities consumed had construct validity in terms of associations with education and tobacco smoking consistent with previous findings of studies (12, 26) in Asian populations. They also had stability across reference periods. The information on alcohol consumption was collected for reference periods of last year and last week with each considered to have advantages and disadvantages that impact on estimates (5). Longer reference periods place the focus on usual patterns of consumption that are able to be recalled reliably if they are generally stable (5, 38). Consumption during shorter periods, such as last week, may be easier to recall but may not be representative of usual consumption (5). These factors may explain the generally weaker results for rural men with last week rather than last year as the reference period. If their consumption pattern is relatively stable over time, any variation last week would result in a misclassification of the risk of usual weekly consumption. Consistent with this, the agreement between usual reported intake last year and actual intake last week was higher for rural respondents than for urban respondents.

Investigation of model calibration and subject discrimination revealed that information from simple questions on whether the respondent had consumed any alcohol at all during the reference period provided most of the gain possible from information on frequency of consumption, number of standard drinks consumed on each drinking occasion, and total intake. For the most part, information on quantities consumed was not independent of frequency of consumption in prediction of outcome. This suggests it would be pointless to increase subject burden by gathering information on frequency and quantity, or on frequency alone, if the only purpose was to improve model calibration and subject discrimination. STEPS protocols emphasize that collecting smaller amounts of good-quality data is more valuable for country-by-country surveillance of non-communicable disease risk factors than is collecting large amounts of poor-quality data (18). Our results suggest that restricting collection of information on alcohol consumption to whether or not respondents consumed alcohol during a relevant reference period would provide the closest alignment with this principle. Elevated blood pressure is only one possible outcome of alcohol consumption, however, and we acknowledge that results may differ for other outcomes such as injury or all-cause mortality.

The present investigation has several strengths. First, the data were collected from a nationally-representative survey of the Vietnamese population. The large sample allowed stratification by sex and rural/urban location, and account to be taken of putative modifying, confounding and mediating factors. The interviews were conducted by trained staff in accordance with standardised WHO protocols designed to minimise random error and bias, and using a culturally-sensitive instrument that had been translated and back-translated. The information on alcohol consumption was as comprehensive as it reasonably could be in a large-scale multiple risk factor survey. It included reports of any alcohol consumption during three reference periods, and frequency of consumption and number of standard drinks consumed during two of those reference periods. That allowed this first investigation of standard drink reporting in Asian countries, and the first with consideration of both model calibration and subject discrimination.

This study has some limitations. Whilst participation was high for a study with overnight fasting, blood sampling and nearly two hours of on-site attendance, the possibility of non-participation bias cannot be discounted. Alcohol consumption was self-reported, but this is standard practice and information collected by this way has been shown to have some evidence of validity (39). In our study, the self-reported data clearly had predictive validity for BP and hypertension as outcomes. It might be argued that our results are specific to those outcomes, and do not attest to validity more generally including for monitoring population levels of alcohol intake. We argue that the urban-rural and reference period comparisons produced important insights independent of those outcomes. Unmeasured factors may be responsible for the urban-rural differences, with salt intake (higher in rural areas) a possible candidate. Adjusting for self-reported information on salty diet did not remove the differences, however. We used version 2.1 of the STEPS questionnaire, and the alcohol questions have been modified in two subsequent iterations of the questionnaire. The current version 3.1 (40) includes additional questions on frequency and quantity of consumption during the past 30 days. Further additional questions have been added on health impacts of drinking, binge drinking and the number of standard drinks consumed during the last seven days from home-brewed, cross-border, non-food (medicines, perfumes, after shave) and non-taxed sources. These add considerably to subject burden and have untested validity. Finally, the questions on alcohol consumption used in all versions of the STEPS questionnaire are an adaption of the quantity/frequency approach (5). We are unable to assess the comparative validity of questions based on the graduated frequency approach (5).

4.6 Conclusions

In conclusion, alcohol use and harmful consumption was common among Vietnamese men but less pronounced than in Western countries. Self-reports of quantity of alcohol consumed in terms of standard drinks had predictive validity for BP and hypertension even in rural areas. Nevertheless, the usefulness of the information is questionable because gains in model calibration and subject discrimination are minor.

4.7 Postscript

The results presented in this chapter refer to alcohol use and its measurement. Whilst less of a problem than in developed countries, harmful alcohol use is common in Vietnam. Because quantities reported in standard drink units had some evidence of predictive validity, it is possible to use this concept in the measurement of alcohol intake in Vietnam including consumption of home-made products. In an attempt to provide comprehensive assessments of all major modifiable lifestyle risk factors, additional data on physical activity and fruit and vegetable consumption will be presented in the following chapters.

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Appendix 4.A. Additional Tables

Additional Table 4.A.1. Association between alcohol consumption and mean systolic, diastolic blood pressure, and hypertension by residential area among women

	Systolic	Diastolic	Hypertension		
	Mean(95%CI)	Mean(95%CI)	%	n/N	PR(95%CI)
Last year consumption					
None	115.5(115.0,116.0)	70.6(70.3,71.0)	11.5%	(1189/7018)	1.00
Any	116.1(114.5,117.6)	70.9(69.8,72.0)	11.2%	(130/878)	0.98(0.74,1.30)
	p=0.509	p=0.693			p=0.899
Frequency of drinking					
None	115.5(115.0,116.0)	70.6(70.3,71.0)	11.5%	(1187/7013)	1.00
<1/month	115.5(113.4,117.6)	70.2(68.8,71.6)	9.3%	(64/476)	0.95(0.68,1.33)
1−3 days/month	114.9(112.5,117.2)	70.8(69.0,72.6)	10.5%	(32/232)	0.88(0.48,1.63)
1−4 days/week	117.7(114.1,121.3)	70.7(68.4,73.1)	15.4%	(21/100)	1.13(0.68,1.88)
5−6 days/week daily	119.4(112.3,126.4)	74.4(68.5,80.3)	15.1%	(12/68)	0.87(0.25,3.06)
Trend	p=0.302	p=0.446			p=0.814
Quantity per occasion†					
None	115.5(115.0,116.0)	70.6(70.3,71.0)	11.5%	(1187/7013)	1.00
<2 drinks/occasion	114.8(113.1,116.6)	70.0(68.8,71.2)	9.5%	(84/617)	0.81(0.58,1.13)
2−3 drinks/occasion	118.7(115.8,121.7)	73.2(71.3,75.2)	10.8%	(29/188)	1.08(0.66,1.77)
3.1−6 drinks/occasion	119.0(113.0,124.9)	72.5(67.2,77.7)	22.9%	(11/55)	2.20(1.00,4.85)
>6 drinks/occasion	118.7(108.1,129.2)	67.0(58.7,75.3)	13.4%	(5/16)	1.31(0.27,6.42)
Trend	p=0.134	p=0.449			p=0.474
Weekly intake‡					
None	115.5(115.0,116.0)	70.6(70.3,71.0)	11.5%	(1187/7013)	1.00
≤1 drink/week	115.2(113.5,116.9)	70.3(69.1,71.4)	9.7%	(89/663)	0.92(0.66,1.27)
1.1−7 drinks/week	117.3(114.2,120.4)	71.6(69.4,73.7)	9.7%	(25/151)	0.77(0.46,1.28)
7.1−14 drinks/week	118.9(114.0,123.8)	73.4(70.2,76.6)	11.1%	(6/36)	0.77(0.28,2.17)
>14 drinks/week	124.2(111.5,136.8)	73.7(61.5,85.9)	42.7%	(9/25)	2.58(0.98,6.78)
Trend	p=0.142	p=0.454			p=0.626
Last month consumption					
None	115.5(115.0,116.0)	70.6(70.3,71.0)	11.4%	(1234/7379)	1.00
Any	116.5(114.6,118.3)	71.1(69.9,72.4)	13.3%	(85/517)	1.15(0.84,1.58)
	p=0.325	p=0.460			p=0.377
Last week consumption					
None	115.5(115.0,116.0)	70.6(70.3,70.9)	11.3%	(1254/7539)	1.00
Any	116.5(115.9,120.5)	72.4(70.7,74.0)	15.5%	(65/357)	1.33(0.92,1.92)
	p=0.023	p=0.041			p=0.128
Frequency of drinking					
None	115.5(115.0,116.0)	70.6(70.3,70.9)	11.3%	(1254/7539)	1.00
1 day	116.2(113.7,118.8)	71.5(69.5,73.4)	14.2%	(35/204)	1.41(0.93,2.13)
2 days	122.1(115.5,128.7)	74.9(70.7,79.1)	23.9%	(9/50)	2.11(1.02,4.37)
3−4 days	118.3(112.2,124.4)	69.9(66.5,73.3)	11.9%	(8/47)	0.84(0.34,2.10)
5+ days	120.8(114.2,127.3)	75.7(70.1,81.3)	15.8%	(13/56)	1.10(0.32,3.74)
Trend	p=0.016	p=0.049			p=0.440

Quantity per occasion‡				
None	115.5(115.0,116.0)	70.6(70.3,70.9)	11.3%(1254/7539)	1.00
<2 drinks/occasion	117.3(114.6,120.1)	72.0(70.2,73.9)	13.9%(43/238)	1.12(0.73,1.74)
2−3 drinks/occasion	117.0(112.1,121.9)	72.0(68.9,75.1)	12.1%(10/75)	1.07(0.45,2.54)
3.1−6 drinks/occasion	125.6(117.7,133.4)	77.6(70.7,84.4)	33.5%(11/34)	3.28(1.51,7.13)
>6 drinks/occasion	118.1(112.3,123.9)	66.3(59.4,73.2)	10.9%(1/10)	1.78(0.22,14.28)
Trend	p=0.008	p=0.109		p=0.032
Weekly intake§				
None	115.5(115.0,116.0)	70.6(70.3,70.9)	11.3%(1254/7539)	1.00
≤1 drink/week	117.0(113.5,120.4)	72.2(69.5,74.9)	16.8%(25/137)	1.52(0.90,2.56)
1.1−7 drinks/week	117.6(114.3,121.0)	72.0(70.0,74.0)	12.7%(30/175)	1.07(0.65,1.77)
7.1−14 drinks/week	120.9(115.8,126.0)	72.9(70.0,75.9)	11.6%(3/24)	0.71(0.16,3.09)
>14 drinks/week	124.9(113.6,136.1)	75.4(63.2,87.6)	33.5%(7/21)	3.91(1.30,11.73)
Trend	p=0.011	p=0.080		p=0.145

* Adjusted for age, education, ethnicity, servings of fruit and vegetable per day and waist circumference.

† Number of standard drinks consumed per occasion when drinking alcohol.

‡ Frequency × quantity.

Additional Table 4.A.2. Calibration of regression models using information on alcohol consumption and other covariates to estimate mean levels of systolic and diastolic blood pressure and the prevalence of hypertension among women, and discrimination between female subjects by model predictions

	Calibration*			Discrimination†		
	Systolic	Diastolic	HTN‡	Systolic	Diastolic	HTN‡
Last year consumption						
Base model §	0.230	0.198	3178.9	0.769	0.759	0.310
Improvement due to D_{LY}¶	0.000	0.000	–1.7	0.000	+0.002	0.000
Improvement due to F_{LY} ¶	+0.002	+0.001	–23.7	–0.002	–0.002	0.000
Improvement due to Q_{LY} ¶	+0.003	+0.002	–32.0	–0.001	+0.007	0.000
Improvement due to (F_{LY}×Q_{LY})	+0.003	+0.001	–31.8	+0.001	+0.002	0.002
Last month consumption						
Base model §	0.233	0.198	3178.9	0.769	0.758	0.310
Improvement due to D_{LM} **	0.000	0.000	–2.7	–0.002	+0.001	0.002
Last week consumption						
Base model §	0.233	0.198	3178.9	0.769	0.758	0.310
Improvement due to D_{LW} ††	+0.001	+0.001	–4.8	+0.003	+0.008	0.012
Improvement due to F_{LW} ††	+0.002	+0.002	–8.7	–0.005	+0.006	0.010
Improvement due to Q_{LW} ††	+0.002	+0.003	–12.4	+0.004	+0.007	0.011
Improvement due to (F_{LW}×Q_{LW})	+0.002	+0.001	–13.4	+0.001	+0.007	0.010

* Indices of calibration are R^2 (systolic and diastolic BP) or deviance (hypertension), with improvement measured by partial R^2 or change in deviance respectively.

† Index of discrimination is the Youden Index (highest 20% of systolic and diastolic BP), with improvement measured by change in the Youden Index.

‡ HTN = hypertension defined as systolic BP ≥140 mmHg or diastolic BP ≥90 mmHg or taking medication for elevated BP.

§ Base model includes covariates for age, education, ethnicity, number of daily servings of fruit and vegetables, smoking and waist circumference.

¶ D_{LY} = whether or not the participant drank alcohol during the last year, F_{LY} = frequency of occasions of drinking alcohol during the last year, Q_{LY} = number of standard drinks consumed on each drinking occasion during the last year.

** D_{LM} = whether or not the participant drank alcohol during the last month.

†† D_{LW} = whether or not the participant drank alcohol during the last week, F_{LW} = frequency of occasions of drinking alcohol during the last week, Q_{LW} = number of standard drinks consumed on each drinking occasion during the last week.

Additional Table 4.A.3.Calibration of regression models using information on alcohol consumption and other covariates to estimate mean levels of systolic and diastolic blood pressure and the prevalence of hypertension among men, and discrimination between male subjects by model predictions

	Urban men (Ho Chi Minh only)					
	Calibration*			Discrimination†		
	Systolic	Diastolic	HTN‡	Systolic	Diastolic	HTN‡
Last year consumption						
Base model §	0.168	0.176	362.2	0.234	0.184	0.225
Improvement due to D_{LY}¶	+0.028	+0.026	–2.1	+0.012	+0.047	+0.019
Improvement due to F_{LY} ¶	+0.037	+0.041	–7.7	+0.048	+0.094	+0.046
Improvement due to Q_{LY} ¶	+0.028	+0.027	–2.9	+0.017	+0.040	+0.032
Improvement due to (F_{LY}×Q_{LY})	+0.041	+0.038	–4.5	+0.039	+0.056	+0.074
Last month consumption						
Base model §	0.168	0.176	362.2	0.267	0.219	0.223
Improvement due to D_{LM} **	+0.018	+0.014	–1.5	–0.030	+0.036	+0.008
Last week consumption						
Base model §	0.168	0.176	362.2	0.267	0.219	0.223
Improvement due to D_{LW} ††	+0.012	+0.014	–1.6	–0.019	+0.011	+0.018
Improvement due to F_{LW} ††	+0.015	+0.016	–3.3	–0.005	+0.010	+0.020
Improvement due to Q_{LW} ††	+0.036	+0.038	–8.9	+0.006	–0.019	+0.017
Improvement due to (F_{LW}×Q_{LW})	+0.015	+0.018	–5.2	+0.009	+0.019	+0.023

* Indices of calibration are R^2 (systolic and diastolic BP) or deviance (hypertension), with improvement measured by partial R^2 or change in deviance respectively.

† Index of discrimination is Youden Index (highest 20% of systolic and diastolic BP), with improvement measured by change in the Youden Index.

‡ HTN = hypertension defined as systolic BP ≥ 140 mmHg or diastolic BP ≥ 90 mmHg or taking medication for elevated BP.

§ Base model includes covariates for age, education, ethnicity, number of daily servings of fruit and vegetables, smoking and waist circumference.

¶ DLY = whether or not the participant drank alcohol during the last year, FLY = frequency of occasions of drinking alcohol during the last year, QLY = number of standard drinks consumed on each drinking occasion during the last year.

** DLM = whether or not the participant drank alcohol during the last month.

†† DLW = whether or not the participant drank alcohol during the last week, FLW = frequency of occasions of drinking alcohol during the last week, QLW = number of standard drinks consumed on each drinking occasion during the last week.

Chapter 5. Physical activity in Vietnam: estimates and measurement issues

5.1 Preface

Chapter 3 and 4 provided extensive information on tobacco smoking and alcohol consumption. Physical activity is another modifiable risk factor for NCD. As is the case for smoking and alcohol intake, nationally-representative data on physical activity are limited in Vietnam. This chapter provides data on physical activity measured by the Global Physical Activity Questionnaire (GPAQ) additional to that presented in Chapter 2. The arising issues when using this questionnaire will be assessed and possible solutions will be provided in this chapter. The contents of this chapter have been published in *PloS One (1).*

5.2 Introduction

Insufficient physical activity (PA) is a health concern in Western countries and is increasingly becoming so in the developing world (2). Physical inactivity accounted for 9.0% of premature mortality worldwide in 2008 (2). Monitoring population levels of total PA is important to guide the public health response to physical inactivity (3). In addition, there is an interest in tracking trends within specific domains. The occupational domain is of particular interest in countries experiencing a shift from physically active occupations, such as farming and forestry, toward more sedentary, office-based occupations (4, 5). Other domains to warrant attention are transportation and discretionary activities, with sedentary activity a recent focus of attention (6).

The GPAQ is used for surveillance of risk factors for NCDs in member countries of the World Health Organization (WHO). GPAQ was developed after a review of available tools and in consultation with experts (7). It was intended as an improvement on the International Physical Activity Questionnaire (IPAQ), but its reliability and validity for use in cross-country comparisons has been found to be no better than that of IPAQ (8). What has not been provided to users of GPAQ is adequate guidance in the use, interpretation and reporting of the information collected. This is a short-coming, because there are specific issues that arise in the administration of a PA questionnaire in developing countries. These include lower levels of literacy, non-familiarity with Western concepts of intensity of effort, and unstable work patterns (9) conditioned on seasonal cycles in rural areas (10). Irrespective of country of application, there are reporting issues that arise because the data are zero-inflated and right-skewed. The GPAQ Analysis Guide (11) provides limited guidance in these respects.

The first aim of this study was to provide the first national estimates of PA for Vietnam. Our second aim was to investigate issues arising in the handling of the data that could have bearing on the accuracy of the estimates and, where possible, to provide solutions and recommendations to assist other users of the questionnaire.

5.3 Methods

5.3.1 Study participants and sampling

The data are from a nationally-representative population-based survey of risk factors for NCDs in Vietnam during 2009–10 that was designed in accordance with the WHO STEPS methodology (7). The details have been presented previously (12). The protocol of this survey was approved by the Ethics Committee of the Vietnam Ministry of Health and the Tasmanian Health and Medical Human Research Ethics Committee. Informed consent was obtained from participants.

5.3.2 Measurements

PA information was collected by face-to-face administration of the GPAQ. Its domains are work (paid or unpaid including study/training, household chores, harvesting food/crops, fishing or hunting for food, and seeking employment), transport (such as to travel to work, for shopping, to market, and to place of worship), and leisure. Vigorous-intensity activities were defined as “activities that require hard physical effort and cause large increases in breathing or heart rate”, and moderate-intensity activities were defined as “activities that require moderate physical effort and cause small increases in breathing or heart rate”. Local examples were depicted on visual aids (see Appendix 8). Respondents were asked whether they engaged in these types of activities for at least 10 minutes continuously and, if so, for how many days they did so in a typical week, and for how long on a typical day. If respondents had a second type of work activity or work that varied with season or month of the year, they were asked to report also in respect of it and indicate the number of months of the year they were engaged in each type of activity. GPAQ expanded questions on sedentary behaviour (sitting or reclining in a typical day) were added to the questions on activity. Socio-demographic, other behavioural, and pathophysiological measurements including weight, height, and total fasting cholesterol were made according to the standardized STEPS procedures (7). The questionnaire was translated into Vietnamese and back-translated to ensure the appropriate meaning of each item was retained (9).

5.3.3 Data analysis

Total time spent on work, transport and leisure time activities of each intensity, weighted by GPAQ-assigned Metabolic Equivalent Task (MET) energy expenditure ratios per kilogram per hour of 4 for moderate and 8 for vigorous intensity activities, were aggregated within and over domains (7). To supplement the information contained in the GPAQ Analysis Guide (11), details on PA coding are provided in the Additional Table 5.A.1. In accordance with the Guide (11), WHO recommendations on PA for health were defined as engaging in at least 150 minutes of moderate-intensity activity per week, or 75 minutes of vigorous-intensity activity per week, or an equivalent combination of moderate and vigorous intensity PA achieving at least 600 MET-minutes per week. Body mass index (BMI) was defined as weight(kgs) $\div$ height(m)^2.

Correlation and regression analysis was used to measure associations between aggregate measures of PA for each province (e.g. the provincial proportions of persons meeting the WHO recommendations for PA) and its geographical, ethnic and climatic characteristics (including the proportion of each provincial population living in areas classified as urban) and with BMI and cardio-metabolic parameters.

Reporting errors in respect of incomplete information, implausible hours of activities (defined as reported total hours per week exceeding 16 hours of activity each day of a typical week), and/or improbable values [defined as reported values of PA requiring energy expenditure greater than average energy intake of the Vietnamese people of 2100 kcal/day (13, 14)] were identified. Log binomial regression (15) was used to compare the estimated probability of any reporting error at levels of putative explanatory factors. Four approaches to minimize the influence of large extreme values on summary (mean) estimates of PA were compared. They were transformation of the outcome variable using a Box-Cox power transformation (with a constant of 1 added to allow its use with zero values) and a shifted Box-Cox transformation (with estimation of the constant to be added that made the mean as close as possible to the median), 10% trimming (setting the weights of the largest 5% and smallest 5% of values to zero), 10% winsorizing (replacing the largest 5% of values with the value of the 95th percentile and the smallest 5% of values with the value of the 5th percentile), and down-sizing the largest values. Three methods of down-sizing were used. They were (a) replacing larger values of total hours per week by 7×16 hours with proportional allocation across sub-domains; (b) replacing larger values of hours per week by 7×3 hours for each domain and sub-domain with proportionate reductions across work and leisure domains (16); and (c) replacing larger values by the level of PA requiring energy expenditure of 2100 kcal/day. All analyses were performed using complex survey methods provided by Stata version 12.0.

5.4 Results

The study sample consisted of 14,706 (53.5% female) subjects aged 25−64 years, with generally higher participation proportions among older persons. Selected characteristics of the study participants, stratified by sex and residential areas, are presented in Table 5.1.

Summary estimates of PA during a typical week in the past year by 25−64 year olds in the Vietnamese population are presented in Table 5.2. Overall, around 20 percent of Vietnamese people were estimated to have no activity of at least moderate intensity for at least 10 minutes at a time during a typical week. Around 70% meet the WHO recommendations for PA by adults aged 18−64 years. Around three quarters do not undertake any measurable leisure-time activity. Work activities are the most common source of reported activity with 55.8% of men and 43.9% of women reporting measurable activity in that domain, whereas transport is the most common source for women with 61.7% of them reporting measurable activity. On average, active persons are estimated to accumulate 100.0 (men) and 47.2 (women) MET-hours per week. For all persons (active and inactive), the estimates are 52.0 (men) or 28.0 (women) MET-hours of PA per week. In addition, Vietnamese people were estimated to sit for 3.4 hours per day. Without data transformation to reduce the influence of extreme values, the estimates (see Additional Table 5.A.2, also Table 5.4) would be 157.7 (men) and 103.4

(women) MET-hours per week for active persons, 132.2 (men) and 89.0 (women) MET-hours per week overall, and 4.0 (men) and 4.0 (women) hours per day of sitting.

Table 5.1. Characteristics of subjects*

	Men		Women	
Characteristic	Urban	Rural	Urban	Rural
Age group				
25–34 years	35.6%(428/2370)	35.9%(995/4434)	35.4%(539/2823)	33.6%(1206/5079)
35–44 years	30.1%(597/2370)	30.6%(1069/4434)	28.5%(700/2823)	29.5%(1225/5079)
45–54 years	23.7%(631/2370)	22.6%(1160/4434)	23.9%(800/2823)	24.1%(1346/5079)
55–64 years	10.6%(714/2370)	10.9%(1210/4434)	12.2%(784/2823)	12.8%(1302/5079)
Ethnicity				
Kinh	95.4%(2249/2359)	93.6%(3377/4428)	95.8%(2673/2815)	94.0%(3933/5074)
Years of schooling: mean(SE)	10.4(0.1)	7.5(0.1)	9.0(0.1)	6.5(0.1)
Monthly income†				
<20 USD	8.0%(190/1900)	18.6%(1024/3903)	7.2%(238/2243)	18.4%(1241/4352)
21–40 USD	13.2%(295/1900)	24.2%(1157/3903)	14.3%(363/2243)	25.7%(1278/4352)
41–60 USD	18.8%(363/1900)	25.3%(801/3903)	19.1%(457/2243)	24.3%(865/4352)
61–80 USD	10.3%(209/1900)	7.7%(305/3903)	8.7%(219/2243)	7.9%(304/4352)
81+ USD	49.7%(843/1900)	24.1%(616/3903)	50.7%(966/2243)	23.7%(664/4352)
BMI				
mean(SE)	21.9(0.1)	20.8(0.1)	21.7(0.1)	20.9(0.1)

* The data presented are mean (standard error, SE) estimated with a shifted Box-Cox power transformation, or weighted percentage (unweighted number in this category/unweighted total number).

† Monthly household income (per adult member).

Table 5.2. Estimated proportions of Vietnamese people without recorded activity, meeting WHO recommendations, and average time spent on physical activity (MET-hours/week) by those with recorded activity and by all persons, and mean time sitting (hours/day)

		Thai Nguyen	Hoa Binh	Ha Noi	Hue	Binh Dinh	Dak Lak	HCMC	Can Tho	Total
Urban population		22.5%(0.0)	12.3%(0.0)	43.3%(0.0)	33.9%(0.0)	26.0%(0.0)	21.8%(0.0)	83.6%(0.0)	67.0%(0.0)	30.3(0.0)
Men										
Work	Not active	9.4%(78)	11.7%(485)	58.7%(300)	39.6%(406)	31.6%(96)	18.4%(667)	72.9%(603)	55.4%(366)	44.2%(2544)
	Active: mean(SE)	230.6(9.1)	195.4(14.8)	79.9(6.7)	107.7(6.6)	165.2(5.5)	207.3(11.2)	165.7(14.9)	79.9(8.2)	133.8(4.0)
	Overall: mean(SE)	208.0(7.8)	177.9(14.5)	0.0(0.0)	13.0(1.6)	96.1(4.0)	160.4(6.8)	0.0(0.0)	2.3(0.3)	13.0(0.7)
Transport	Not active	40.3%(325)	25.0%(484)	67.8%(414)	62.0%(261)	50.3%(278)	39.3%(258)	75.0%(316)	36.3%(386)	54.1%(3154)
	Active: mean(SE)	39.2(3.0)	24.0(2.7)	17.9(2.1)	14.9(1.2)	24.5(1.7)	19.0(0.9)	21.0(1.7)	14.3(1.3)	19.7(1.0)
	Overall: mean(SE)	14.0(1.5)	15.9(1.7)	0.0(0.0)	0.0(0.0)	1.9(0.2)	8.0(0.6)	0.0(0.0)	6.0(0.4)	0.0(0.0)
Leisure	Not active	88.0%(857)	79.6%(378)	57.4%(702)	80.5%(594)	79.8%(1001)	71.7%(784)	69.7%(506)	76.2%(849)	74.4%(5110)
	Active: mean(SE)	22.0(4.4)	23.3(6.9)	19.5(1.4)	14.0(0.0)	16.1(1.5)	19.3(2.5)	16.0(1.2)	14.0(1.5)	17.2(0.0)
	Overall: mean(SE)	0.0(0.0)	0.2(0.0)	0.0(0.0)	0.2(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
Total	Not active	3.0%(20)	5.0%(157)	22.4%(100)	23.4%(116)	9.8%(33)	3.9%(186)	41.0%(129)	17.0%(152)	19.7%(995)
	Active: mean(SE)	250.0(9.6)	223.7(15.7)	48.7(3.9)	91.5(6.3)	146.9(4.5)	191.1(7.0)	48.3(4.5)	45.6(3.5)	100.0(2.4)
	Overall: mean(SE)	246.2(9.0)	213.7(16.8)	27.0(3.1)	35.0(3.2)	127.5(3.8)	182.5(6.7)	14.0(1.3)	28.7(1.8)	52.0(2.0)
Meet WHO recommendations		95.1%(925)	92.5%(504)	67.1%(746)	67.5%(542)	86.6%(1029)	92.5%(587)	51.2%(672)	69.9%(818)	72.9%(5369)
Sedentary: mean(SE)		3.7(0.1)	3.2(0.3)	6.3(0.2)	4.0(0.1)	3.0(0.1)	2.1(0.1)	2.9(0.1)	2.0(0.1)	3.4(0.0)

		Thai Nguyen	Hoa Binh	Ha Noi	Hue	Binh Dinh	Dak Lak	HCMC	Can Tho	Total
Women										
Work	Not active	9.9%(138)	18.1%(334)	62.5%(636)	54.9%(167)	36.0%(176)	23.9%(225)	90.1%(548)	71.1%(867)	56.1%(3548)
	Active: mean(SE)	156.5(8.7)	180.9(25.1)	56.0(4.9)	70.3(4.3)	130.7(4.9)	136.3(6.3)	93.7(9.9)	24.0(2.6)	85.3(2.5)
	Overall: mean(SE)	137.4(7.2)	145.2(21.9)	0.0(0.0)	0.7(0.1)	64.3(3.7)	98.7(6.2)	0.0(0.0)	0.0(0.0)	0.0(0.0)
Transport	Not active	31.8%(250)	18.1%(481)	39.8%(612)	38.9%(327)	39.7%(194)	34.8%(274)	58.2%(367)	25.5%(545)	38.3%(2618)
	Active: mean(SE)	28.7(2.0)	27.2(1.5)	16.4(0.8)	18.7(1.0)	23.5(1.2)	21.6(2.2)	14.0(1.4)	15.7(0.8)	18.7(0.5)
	Overall: mean(SE)	13.3(0.9)	18.7(1.7)	7.4(0.4)	8.7(0.6)	9.3(0.5)	10.5(0.6)	0.0(0.0)	9.3(0.6)	8.4(0.2)
Leisure	Not active	89.9%(727)	89.1%(677)	64.2%(543)	84.4%(632)	84.1%(921)	77.8%(765)	72.7%(851)	83.7%(650)	79.5%(6327)
	Active: mean(SE)	22.7(0.0)	12.9(0.0)	16.2(1.6)	16.5(1.0)	13.2(1.0)	17.2(2.0)	12.5(0.0)	16.3(1.0)	14.3(0.0)
	Overall: mean(SE)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.4(0.0)
Total	Not active	3.9%(50)	9.7%(183)	17.9%(330)	23.3%(39)	15.4%(75)	5.5%(44)	42.1%(213)	18.3%(374)	20.8%(1206)
	Active	177.6(8.7)	204.6(25.8)	41.5(2.6)	53.3(3.0)	119.5(4.7)	127.7(6.4)	22.9(1.6)	25.3(1.3)	47.2(1.1)
	Overall: mean(SE)	169.1(8.2)	183.0(23.6)	30.9(1.7)	28.0(1.9)	92.3(4.0)	119.4(6.5)	7.0(0.4)	16.8(1.0)	28.0(0.8)
Meet WHO recommendations		94.0%(817)	87.7%(593)	70.6%(439)	69.8%(803)	79.1%(910)	90.8%(859)	45.8%(721)	62.8%(495)	69.1%(6091)
Sedentary: mean(SE)		3.6(0.1)	3.6(0.1)	5.7(0.2)	3.9(0.1)	3.0(0.1)	2.2(0.1)	3.2(0.1)	1.8(0.1)	3.3(0.0)

Mean (standard errors, SE) estimated with a shifted Box-Cox power transformation.

Estimated proportions of the Vietnamese population meeting specified criterion values of PA are depicted in Figure 5.1. In rural areas, 58.8% of men and 47.3% of women had a high level of PA as defined by WHO (at least 3000 MET-minutes per week), whilst around three quarters have at least 600 MET-minutes per week. The proportions with high PA were much lower among their urban counterparts.

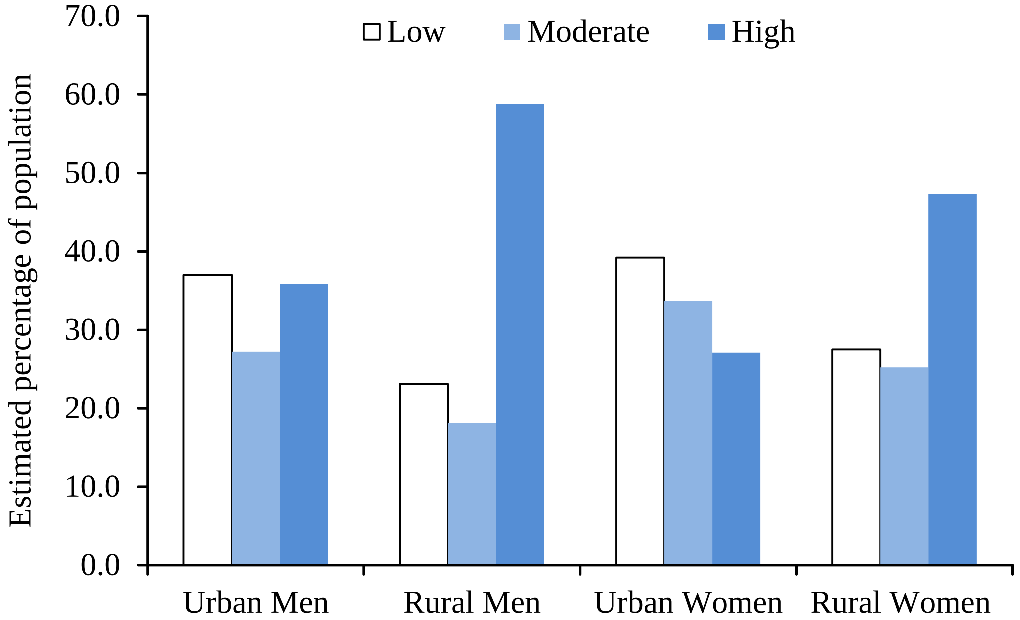

Figure 5.1. Estimated proportions of the Vietnamese population not meeting the WHO recommendation of achieving at least 600 MET-minutes of activity per week (low), at least 600 MET-minutes but not 3000 MET-minutes per week (moderate), or at least 3000 MET-minutes per week (high level of activity)

The percentage of Vietnamese people meeting the 75/150 WHO recommendations ranges from around 90% in the three least urbanised provinces (Hoa Binh, Dak Lak, Thai Nguyen) to around one-half (men 51.2%, women 45.8%) in HCMC, the most urbanised province of the largest city in Vietnam. The variation in proportions not active at work and overall, and in mean MET-hours at work and overall, follows a similar pattern. Residents of Ha Noi have the highest proportion of participation in leisure activity, but spend the most time sitting. These patterns of PA are replicated in urban and rural areas of each province (see Additional Table 5.A.3), but with time spent on each sub-domain up to 98 percent higher in rural areas than in urban areas.

The provincial proportions meeting the WHO recommendations (men r=−0.88, women r=−0.93), and of those active at work (men r=−0.91, women r=−0.93) and overall (men r=−0.86, women r=−0.84), and the provincial mean levels of PA (men r=−0.79, women r=−0.82), were each inversely associated with the provincial proportions of urban population. There were weaker associations of the aggregate PA measures with the latitude, altitude, average temperature, rainfall and proportion of minority ethnicity of each province (see Additional Table 5.A.4), and adjusting for the urban proportion of each province reduced each association other than those with rainfall.

The inverse associations with rainfall brought into question the seasonal timing of the survey. Overall, 92.1% (12,924/14,706) of respondents were interviewed in the wet season [months of the year when the average rainfall exceeds 60mm (17)]. For five provinces, we were able to compare PA for those interviewed in the wet season and those in the same province interviewed in the dry season. The means were 34.7 (wet season) and 84.0 (dry season) MET-hours/week, but this ordering was reversed in the rural provinces of Hoa Binh (210 vs 140 MET-hours/week), Binh Dinh (140 vs 110 MET-hours/week) and Dak Lak (168 vs 158 MET-hours/week). The results of re-scaling the dry season values for each sub-domain to have the same median in each age, sex and urban/rural stratum as the wet season values are shown in the Additional Table 5.A.5. The impacts were negligible on the national estimates, but of consequence for the provincial estimates for Binh Dinh where 45.6% (772/1,911) of respondents were interviewed in the wet season, and Dak Lak where 88.8% (1509/1809) of interviews took place in the wet season. The median estimates of total activity were increased by 7% (Binh Dinh) and 5% (Dak Lak) for men in those provinces, and by 2% (Binh Dinh) and 0% (Dak Lak) for women.

Table 5.3 reports the frequency of identifiable errors in reporting PA with the GPAQ questionnaire. On its core section, 135 of the 14,706 respondents failed to provide complete PA information. Another 128 respondents reported more than 7×16=112 hours of activity per typical 7-day week, and 2395 other respondents reported levels of usual activity that improbably required energy expenditure every day of a typical week in excess of the average energy intake (2100 kcals) of Vietnamese people. Another 1007 respondents made errors of omission or reported unrealistically high values on two sets of added questions (those in respect of a second type of work activity and sedentary non-activity). The sum totals were 5958 errors made by 3665 different respondents.

Table 5.3. Frequency of errors (item non-response and implausible or improbable responses) in reporting physical activity with the WHO GPAQ questionnaire (N=14706)

	Missing		Implausible‡		Improbable**	
Domains	Number*	Respondents†	Number§	Respondents†	Number¶	Respondents†
Core questions						
Balance brought forward		0		135		263
Work type 1						
Vigorous	28	28	0	135	1407	1558
Moderate	26	50	7	142	652	2184
Transport	57	104	116	251	484	2617
Leisure						
Vigorous	7	110	46	253	17	2634
Moderate	27	135	56	263	24	2658
Added questions						
Balance brought forward		2658		2931		3081
Work type 2						
Monthly allocation	55	2697	0		0	
Vigorous	7	2701	499	3078	227	3262
Moderate	8	2708	52	3078	547	3540
Sedentary	249	2931	515	3081	845	3665

* Number of item non-responses.

† Cumulative number of different respondents.

‡ Reported physical activity >112 hours per week (7 days × 16 hours/day), in near accordance with Global Physical Activity Questionnaire Analysis Guide.

§ Number of item non-responses and implausible values.

¶ Number of item non-responses, implausible values and improbable values.

**Energy expenditure from reported activity > average energy intake per day of Vietnamese people (2100 kcal).

The 2954 reporting errors made by 2658 persons on core questions were more frequently made by men and particularly the less well-educated among them, younger persons, all those who reported a second type of work activity and residents of rural areas who did not (interaction p<0.001), those of non-Kinh ethnicity, and persons from low-income households (see Additional Table 5.A.6).

The option to report a second type of activity was taken up by 840 respondents (465 men and 375 women) of whom 87.6% (720/840) were from rural areas. The average time they spent on each activity was 7.1 (SD 2.3) months for the first activity and 4.9 (SD 2.2) for the second activity. The work PA levels of respondents who reported a second activity were 67.3%

higher (335.9 vs 109.7 MET-hours/week) than of those without a second type of activity, with total PA that was 60.1% (357.3 vs 140.9 MET-hours/week) higher. The most common types of second activity (see Additional Table 5.A.7) were farming, construction (men), and house-keeping (women).

Estimates of self-reported time spent on PA made with alternative approaches of minimising the influence of large values are presented for men and women in Table 5.4. The shifted Box-Cox transformation of these data produced mean estimates that most closely approximated the weighted median values (the zero values of PA required a constant to be added, and the constant was chosen to ensure this). A Box-Cox transformation with an added constant of 1 produced estimates that were comparable but generally less accurate (87.4, 48.1, 47.3 and 26.9 MET-hours/week by active men, all men, active women and all women respectively). Of the other methods, down-sizing category totals according to the IPAQ guidelines (maximum 7×3 hours/week) provided summary values that were most comparable to data transformation. Each of the methods was more successfully applied to the data for active persons (no zero values) than to the data for all persons. The results were similar for urban and rural areas (data not shown).

Table 5.5 shows that work activity and total PA were negatively correlated with BMI, and transport activity more weakly so, while leisure-time activity was positively correlated with BMI. The strongest correlations between time spent on work activity (or total PA) and BMI were produced by the energy-scaling method consistently across strata of sex and activity and within domains of strata. The associations are generally similar when stratified by urban/rural residence (data not shown). These findings were replicated with fasting total cholesterol (data not shown).

Table 5.4. Estimates of self-reported time spent on physical activity (MET-hours/week) made with alternative approaches to reducing the influence of improbably and/or implausibly large values

		Mean (SE)*						
Subjects and domains	Median (IQR)†	As measured	Box-Cox transformed‡	10% trimmed§	10% winsorized¶	Down-sized (total hours)**	Down-sized (category hours)††	Down-sized (energy expenditure)‡‡
Active men								
Work activity	148.0(80.0,224.0)	179.1(5.5)	133.8(4.0)	162.9(4.5)	170.4(4.8)	178.8(5.5)	84.5(2.1)	150.9(3.9)
Transport	19.7(12.7,30.3)	34.6(2.6)	19.7(1.0)	27.9(0.9)	31.1(1.2)	34.5(2.6)	29.0(1.0)	30.7(1.9)
Leisure activity	17.3(11.0,28.0)	24.9(0.0)	17.2(0.0)	21.0(0.0)	22.7(0.0)	24.8(0.0)	13.0(0.0)	23.2(0.0)
Total activity	100.0(39.0,192.7)	157.7(4.1)	100.0(2.4)	139.4(3.2)	149.5(3.6)	157.3(4.1)	81.7(1.9)	133.5(2.9)
All men								
Work activity	13.0(0.0,132.0)	110.1(3.5)	13.0(0.7)	90.5(2.7)	102.0(3.1)	109.9(3.5)	51.2(1.5)	91.5(2.6)
Transport	0.0(0.0,9.3)	15.5(0.7)	0.0(0.0)	10.6(0.4)	13.7(0.5)	15.5(0.7)	13.7(0.5)	13.8(0.6)
Leisure activity	0.0(0.0,0.0)	6.4(0.4)	0.0(0.0)	3.6(0.2)	4.8(0.2)	6.4(0.4)	3.4(0.2)	6.0(0.3)
Total activity	52.0(18.7,152.0)	132.2(3.6)	52.0(2.0)	113.3(2.9)	123.6(3.2)	131.9(3.6)	68.4(1.6)	111.4(2.7)
Active women								
Work activity	98.0(42.7,168.0)	126.4(3.8)	85.3(2.5)	110.5(3.1)	119.4(3.5)	126.1(3.8)	73.7(2.1)	115.2(3.2)
Transport	18.7(14.0,28.0)	29.5(0.9)	18.7(0.5)	24.7(0.6)	26.5(0.6)	29.4(0.9)	26.5(0.6)	28.0(0.8)
Leisure activity	14.0(10.7,24.0)	20.4(0.0)	14.3(0.0)	17.6(0.0)	18.8(0.0)	20.3(0.0)	14.1(0.0)	19.5(0.0)
Total activity	42.0(24.0,112.0)	103.4(2.5)	47.2(1.1)	85.6(1.7)	95.2(2.0)	103.2(2.5)	66.6(1.2)	94.3(2.0)
All women								
Work activity	0.0(0.0,50.7)	66.2(2.2)	0.0(0.0)	47.8(1.3)	57.3(1.6)	66.1(2.2)	36.9(1.0)	59.0(1.8)
Transport	9.3(0.0,14.0)	18.4(0.5)	8.4(0.2)	13.8(0.3)	16.6(0.4)	18.3(0.5)	16.6(0.4)	17.5(0.5)
Leisure activity	0.0(0.0,0.0)	4.4(0.3)	0.4(0.0)	2.4(0.1)	3.4(0.2)	4.4(0.3)	3.1(0.2)	4.2(0.2)
Total activity	28.0(13.7,92.0)	89.0(2.3)	28.0(0.8)	70.4(1.4)	80.4(1.8)	88.8(2.3)	56.6(1.1)	80.7(1.8)

* Mean (standard error, SE) estimated by the Hansen-Hurwitz estimator for cluster survey designs with clusters sampled with unequal probabilities and with replacement.

† Median (interquartile range).

‡ Summary values estimated with a shifted Box-Cox transformation.

§ Top 5% and bottom 5% distribution set to missing, and non-missing data reweighted.

¶ Top 5% and bottom 5% of distribution reset to 95th and 5th percentiles respectively.

** Total hours per week reset to 7×16 hours if in excess of 7×16 hours (this allows a person to work more than 16 hours per day on some days of the week) with proportional allocation across sub-domains.

†† Total transport, total moderate–intensity activity (work and leisure) and total vigorous-intensity activity (work and leisure) per week each reset to 7×3 hours if in excess of 7×3 hours, with proportionate reductions across work and leisure domains.

‡‡ Reported values set to the level of physical activity requiring energy expenditure of 2100 kcal/day.

Table 5.5. Association of estimates of self-reported time spent on physical activity (MET-hours/week), made with alternative approaches to reducing the influence of improbably and/or implausibly large values, with BMI

Subjects and domains	Pearson product-moment correlations							
	As measured	Box-Cox transformed†	10% trimmed‡	10% winsorized§	Down-sized (total hours)¶	Down-sized (category hours)††	Down-sized (energy expenditure)‡‡	Rank correlation
Active men								
Work activity	–0.110***	–0.111***	–0.092***	–0.112***	–0.112***	–0.065***	–0.157***	–0.111***
Transport	0.017	–0.017	–0.012	–0.009	0.016	–0.012	–0.001	–0.018
Leisure activity	0.057*	0.056*	0.059***	0.082**	0.061*	0.017	0.062*	0.058*
Total activity	–0.103***	–0.108***	–0.086***	–0.104***	–0.105***	–0.085***	–0.143***	–0.112***
All men								
Work activity	–0.101***	–0.097***	–0.090***	–0.103***	–0.103***	–0.086***	–0.133***	–0.102***
Transport	–0.046***	–0.074***	–0.053***	–0.066***	–0.047***	–0.066***	–0.060***	–0.075***
Leisure activity	0.079***	0.103***	0.096***	0.105***	0.080***	0.080***	0.086***	0.106***
Total activity	–0.097***	–0.092***	–0.086***	–0.099***	–0.099***	–0.090***	–0.133***	–0.093***
Active women								
Work activity	–0.062***	–0.064***	–0.041***	–0.066***	–0.062***	–0.035*	–0.097***	–0.059***
Transport	–0.014	0.001	–0.024**	–0.016	–0.015	–0.016	–0.030*	–0.007
Leisure activity	0.154***	0.218***	0.156***	0.205***	0.168***	0.144***	0.200***	0.223***
Total activity	–0.074***	–0.058***	–0.092***	–0.084***	–0.075***	–0.071***	–0.106***	–0.072***
All women								
Work activity	–0.095***	–0.116***	–0.101***	–0.108***	–0.095***	–0.098***	–0.125***	–0.120***
Transport	–0.035*	–0.050***	–0.049***	–0.045***	–0.035*	–0.045***	–0.046***	–0.056***
Leisure activity	0.147***	0.140***	0.126***	0.166***	0.153***	0.144***	0.161***	0.169***
Total activity	–0.083***	–0.077***	–0.084***	–0.094***	–0.084***	–0.085***	–0.114***	–0.082***

* p<0.05, **p<0.01, ***p<0.001, all model were adjusted for age, years of education, smoking, and alcohol consumption.

† Summary values estimated with a shifted Box-Cox transformation.

‡ Top 5% and bottom 5% distribution set to missing, and non-missing data reweighted.

§ Top 5% and bottom 5% of distribution reset to 95th and 5th percentiles respectively.

¶ Total hours per week reset to 7×16 hours if in excess of 7×16 hours (this allows a person to work more than 16 hours per day on some days of the week) with proportional allocation across sub-domains.

†† Total transport, total moderate-intensity activity (work and leisure) and total vigorous-intensity activity (work and leisure) per week each reset to 7×3 hours if in excess of 7×3 hours, with proportionate reductions across work and leisure domains.

‡‡ Reported values set to the level of physical activity requiring energy expenditure of 2100 kcal/day.

5.5 Discussion

Around 70 percent of Vietnamese persons aged 25−64 years meet the WHO recommendations of PA for health, and around 20 percent had no activity that required at least small increases in breathing or heart rate over a period of at least 10 minutes during a typical week. On average, reported activity was 52.0 MET-hours (men) or 28.0 MET-hours (women). Consistent with previous local surveys (18, 19) and recent studies in both developing and developed nations (20-23), work activities contributed the vast bulk of recorded activity. Measurable travel takes up 18 minutes/day for the average Vietnamese woman, but almost no time for the average Vietnamese man, and three quarters undertake no leisure activities that are measurable by these methods. Work and total activity were significantly higher in less urbanised provinces and in the rural areas of each province.

Our estimated proportions of Vietnamese people meeting the WHO recommendations are similar to those from a previous survey in Vietnam (24). They are also similar to the results of pooled analyses of GPAQ survey results in five Asian countries (21) and 22 African countries (20). The first used an old version of the WHO recommendation that, if applied in our study, would have reduced the proportions by 3.3 (men) or 2.5 (women) percentage points. The pooled analysis of 51 mainly developing countries produced higher estimates using the IPAQ questionnaire, but overestimation of PA by IPAQ has been identified previously (25-27). The common feature of the three pooled analyses is the heterogeneity in the country-specific estimates that was attributed to the timing of the surveys given seasonal patterns of agricultural activities (21, 22), differences in the culture and religion (20, 21), and reporting errors (20-22). Between-country differences in urbanization were speculated (20-22) to be a possible contributor. We too found considerable variation in PA, but between the provinces of a single country, and the strongest predictor of that variation – explaining 60 to 86 percent – was the urban population proportion of each province. Consistent with this, analyses of national survey data from China during 1991–2006 (4) showed that more than four-fifths of the decline in occupational PA for men, and nearly two-thirds of the decline for women, were predicted by factors associated with urbanization. Occupational PA comprises a major portion of total PA in Vietnam and, unless PA in other domains (transport and leisure) can be increased to compensate, overall PA will decline if occupational PA diminishes in response to further industrialization.

The second aim of this study was to investigate issues arising in the use of the GPAQ instrument and in analysis of the data collected that could influence the accuracy of the estimates. A recent assessment (8) is that the GPAQ has only poor to fair criterion validity but nonetheless was considered a suitable and acceptable instrument for monitoring the PA of populations. Similar conclusions specifically for the Vietnamese population were reached in a study (10) conducted in the highly urbanised province of HCMC, even though the validity of the instrument in rural Vietnam, where 70% of the population lives and educational standards are lower (12), is untested.

The previous HCMC study provided the important caveat that seasonal PA differences between the wet and dry seasons have to be taken into account. We found that reported PA levels were higher in the dry season in urbanised provinces, but the reverse was the case in rural provinces where the wet season coincides with harvest time and requires high activity levels irrespective of the conditions. GPAQ seeks reporting of PA in a typical day of a typical week, but these and other (21, 22) results suggest respondents in developing countries are unduly influenced in reporting by their most recent activity. Adjusting for the wet/dry differences made almost no difference overall, but the provincial estimates were decreased in more urbanised provinces and increased in less urbanised provinces.

In relation to other complex constructs of GPAQ, 98% of respondents were able to complete the interviewer-administered questionnaire but around one-in-six reported unrealistically large values. Over-estimation of self-reported PA in response to the GPAQ instrument when administered in the Vietnamese population has been described previously (10). In our study, most respondents who did not complete the questionnaire or provided exaggerated values were those from rural areas where educational levels are lowest, and familiarity with Western concepts of intensity and continuity of effort would be least. Our group (9) identified that seasonal stability of work patterns influenced the reporting of PA by GPAQ in a study conducted in Can Tho province, and we modified GPAQ for use in this study by allowing respondents to report a second type of work activity. Only around 6% of the sample did so, but more than 80% of those who did were from rural areas. Reporting errors were most common among rural respondents and all those who reported a second work activity. This was independent of education levels, suggesting that work activities in the rural setting are difficult to report accurately and that unstable work patterns add to the difficulty irrespective of urban/rural location.

Of the several methods for handling the zero-inflated and right-skewed data, the shifted Box-Cox transformations produced the most plausible summary values of PA. For data with zero values, a Box-Cox transformation requires a constant to be added to each observation, and we added the value that produced a design-based mean most like the corresponding median in each stratum and sub-domain. Searching for this value was straightforward and feasible to do. A Box-Cox transformation with a constant of 1 added produced comparable but generally less accurate results.

Significantly protective associations were observed between work and transport activity and NCD risk factors including body size/fatness and cholesterol. These findings are biologically plausible and underline the potential importance of work-related sources of PA in preventing NCD in this population. In contrast to previous findings in developed populations (28), but consistent with that of a previous investigation conducted in the Chinese population (29), leisure-time activity was positively associated with body size/fatness (or cholesterol), even after adjusting for a number of potential confounding factors. That leisure-time activity was most common among well-educated and high income persons living in urban areas, who were less active in other domains (work and transport), may provide the explanation. Interestingly, whilst the shifted Box-Cox transformations provided the most plausible summary estimates, the strongest correlations were produced by energy-scaled values that reduced reported PA to maximum values more consistent with average energy intake in the Vietnamese population.

The present investigation has several strengths. First, the data were collected from a nationally-representative survey of the Vietnamese population. The large sample and the comprehensive measurements of PA across all domains allowed analyses stratified by sex and rural/urban location. The availability of data on other behavioural risk factors for NCD made it possible to take account of putative confounding and mediating factors. The interviews were conducted by trained staff in accordance with standardised protocols (7) designed to minimise avoidable sources of random error and bias, and using a culturally-sensitive instrument that had been translated and back-translated. The GPAQ instrument had been tested for use in the Vietnamese population (9, 10), and modified by us to take account of some of its shortcomings (9).

However, our study has limitations. Whilst the response proportion was high for a study requiring lengthy clinic attendance with overnight fasting and blood-sampling, the possibility of non-participation bias cannot be discounted. Secondly, measurements by GPAQ are acknowledged (8-10) to be subject to very substantial error. Measurement of PA by more accurate and objective devices such as motion sensors would be an improvement, but such methods are infeasible for large-scale field work in many low resource countries including Vietnam. Furthermore, we did not measure some important risk factors for NCD including total energy intake, and failing to adjust for such factors may have influenced the findings.

5.6 Conclusions

In conclusion, seven-in-ten Vietnamese people aged 25–64 years meet WHO recommendations for total PA, which was mainly from work activities and higher in rural areas. Nearly all respondents were able to report their activity in response to GPAQ, but with some exaggerated values and seasonal variation in reporting. Data transformation provides plausible summary values, but energy-scaling fared best in association analyses.

5.7 Postscript

The research presented in this chapter has shown that Vietnamese people are relatively active due largely to the physical nature of their work. The urban-rural differences may be a portent of future declines. Caveats on the measurements of PA by the GPAQ were identified. Additional information on the fourth modifiable behavioural risk factor, fruit and vegetable consumption, will be presented in the following chapter.

5.8 References

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Appendix 5.A. Additional Tables

Additional Table 5.A.1. Coding rules

No	Description
1.	Replace recorded missing codes (77, 88, 99) with missing value.
2.	Replace HRS = 0 if hours are not recorded but days and minutes are recorded.
3.	Replace MINS = 0 if minutes are not recorded but days and hours are recorded.
4.	Replace activity code (1 = yes, 2 = no) with ACTIVE = 1 if ACTIVE ≠ 1 and days are recorded but not recorded as 0, and hours are recoded.
5.	Replace activity code (1 = yes, 2 = no) with ACTIVE = 2 if ACTIVE ≠ 2 and days are not recorded or recorded as 0, and hours are not recorded or recorded as 0.
6.	Replace DAYS = 0 if DAYS ≠ 0 and ACTIVE = 2.
7.	Replace HRS = 0 if HRS ≠ 0 and ACTIVE = 2.
8.	Replace MINS = 0 if MINS ≠ 0 and ACTIVE = 2.
9.	Replace wMONTH1 = 12 if wMONTH1 = missing and wDESC2 = missing and (wMONTH2 = missing or wMONTH2 = 12).
10.	Replace wMONTH1 = 12 – wMONTH2 if wMONTH1 = missing and 0≤wMONTH2<12 and wDESC2 = missing.
11.	Replace wMONTH2 = 0 if wMONTH2 = missing and WORK2_ACTIVE = 2.
12.	Replace wMONTH2 = 2 if wMONTH2 = missing and wMONTH1=12 and wDESC2 = missing and WORK2_ACTIVE = 1 for either or both vigorous and moderate activity and not (wDAYS1 != wDAYS2 and wHRS1 != wHRS2 and wMINS1 != wMINS2).
13.	Replace wMONTH2 = 12 – wMONTH1 if 0 ≤ wMONTH1 < 12 and wMONTH2 = missing and wDESC2 = missing and not (wDAYS1 != wDAYS2 and wHRS1 != wHRS2 and wMINS1 != wMINS2).
14.	Replace wMONTH2 = 12 if wMONTH1=12 and wMONTH2 = missing and wDESC2 =

missing and not (wDAYS1 != wDAYS2 and wHRS1 != wHRS2 and wMINS1 != wMINS2).

15. Replace wMONTH2 = 6 if wMONTH2 = missing and wMONTH1=12 and wDESC2 = not missing and WORK2_ACTIVE = 1.

16. Replace wMONTH2 = 12 – wMONTH1 if 0≤wMONTH1<12 and wMONTH2 = missing and wDESC2 = not missing.

17. Replace wMONTH2 = 12 if wMONTH1=12 and wMONTH2 = missing and wDESC2 = not missing.

DAYS, HRS, and MINS: number of days per week, number of hours per day, and number of minutes per day for all activity.

ACTIVE: whether or not work, transport, and leisure involved vigorous- or moderate-intensity activity.

wMONTH1, wDESC1, wDAYS1, wHRS1, and wMINS1: number of months per year, job title, number of days per week, number of hours per day, and number of minutes per day for the first work activity (the first job).

WORK2_ACTIVE: whether or not work involved vigorous- or moderate-intensity activity for the second job.

wMONTH2, wDESC2, wDAYS2, wHRS2, and wMINS2: number of months per year, job title, number of days per week, number of hours per day, and number of minutes per day for the second work activity (the second job).

Additional Table 5.A.2. Average time spent on physical activity (MET-hours/week) by those with recorded activity and by all persons, and mean time sitting (hours/day)

		Thai Nguyen	Hoa Binh	Ha Noi	Hue	Binh Dinh	Dak Lak	HCMC	Can Tho	Total
Men										
Work										
	Active: mean(SE)	290.2(11.3)	228.5(15.8)	118.4(10.3)	145.6(9.0)	184.8(6.3)	248.9(15.7)	204.8(18.3)	136.2(14.1)	179.1(5.5)
	Overall: mean(SE)	268.3(10.0)	206.8(16.6)	54.4(7.9)	92.8(7.0)	127.7(5.3)	207.6(12.6)	59.4(7.5)	60.1(6.5)	110.1(3.5)
Transport										
	Active: mean(SE)	46.3(3.2)	38.1(5.0)	37.8(9.8)	28.6(3.9)	41.0(3.3)	26.1(1.9)	33.5(2.9)	31.0(3.4)	34.6(2.6)
	Overall: mean(SE)	28.9(2.6)	29.3(4.8)	10.5(1.6)	10.7(1.2)	19.8(1.5)	15.9(1.3)	8.4(1.1)	19.5(2.3)	15.5(0.7)
Leisure										
	Active: mean(SE)	45.6(0.0)	33.6(0.0)	25.9(0.0)	21.1(0.0)	23.1(0.0)	28.3(0.0)	20.3(0.0)	21.7(0.0)	24.9(0.0)
	Overall: mean(SE)	6.9(1.6)	6.4(1.1)	11.1(1.1)	4.1(0.6)	4.9(0.7)	7.8(1.2)	6.3(0.6)	5.4(0.9)	6.4(0.4)
Total										
	Active: mean(SE)	312.4(11.1)	252.2(19.1)	95.5(8.6)	142.3(10.5)	169.1(5.4)	238.9(12.4)	122.5(11.9)	103.9(8.0)	157.7(4.1)
	Overall: mean(SE)	304.1(10.6)	242.5(19.9)	76.0(8.5)	107.7(7.3)	152.3(4.9)	231.3(12.5)	74.0(7.8)	85.2(6.5)	132.2(3.6)
Sitting										
	mean(SE)	4.1(0.1)	3.9(0.4)	6.8(0.2)	4.5(0.1)	3.3(0.1)	2.3(0.1)	3.3(0.1)	2.4(0.1)	4.0(0.1)
Women										
Work										
	Active: mean(SE)	221.3(11.6)	214.4(29.9)	96.4(9.6)	106.3(8.0)	146.8(5.3)	178.1(10.2)	120.6(10.9)	54.8(5.4)	126.4(3.8)
	Overall: mean(SE)	203.1(11.3)	180.8(29.2)	39.9(4.7)	50.8(4.1)	97.4(5.1)	145.5(10.6)	11.9(1.8)	17.0(2.2)	66.2(2.2)
Transport										
	Active: mean(SE)	38.3(2.3)	38.5(3.2)	28.1(2.0)	29.8(1.8)	33.2(1.5)	30.7(4.1)	24.5(3.4)	27.6(1.6)	29.5(0.9)
	Overall: mean(SE)	26.1(1.7)	31.7(2.7)	16.7(1.0)	18.8(1.3)	20.0(1.1)	19.6(2.1)	10.4(1.2)	20.8(1.3)	18.4(0.5)
Leisure										
	Active: mean(SE)	34.0(0.0)	21.3(0.0)	21.6(0.0)	19.0(0.0)	17.5(0.0)	28.4(0.0)	17.5(0.0)	19.7(0.0)	20.4(0.0)
	Overall: mean(SE)	4.1(0.9)	1.8(0.5)	8.5(0.8)	2.9(0.4)	3.0(0.4)	5.5(1.0)	4.9(0.6)	3.3(0.4)	4.4(0.3)
Total										
	Active: mean(SE)	241.5(12.6)	232.8(30.2)	76.4(5.6)	93.3(5.3)	142.0(5.4)	178.5(11.6)	45.4(3.7)	50.5(2.9)	103.4(2.5)
	Overall: mean(SE)	233.4(11.8)	214.3(28.5)	65.1(4.9)	72.6(4.7)	120.5(5.2)	170.6(11.3)	26.8(2.5)	41.1(2.4)	89.0(2.3)
Sitting										
	mean(SE)	4.0(0.1)	4.4(0.1)	6.3(0.2)	4.5(0.1)	3.3(0.1)	2.5(0.1)	3.7(0.1)	2.2(0.1)	4.0(0.1)

Mean (standard error, SE) estimated by the Hansen-Hurwitz estimator for cluster survey designs with clusters sampled with unequal probabilities and with replacement.

Additional Table 5.A.3. Estimated proportions of Vietnamese people without recorded activity, meeting WHO recommendations, and average time spent on physical activity (MET-hours/week) by those with recorded activity and by all persons, and mean time sitting (hours/day)

		Thai Nguyen	Hoa Binh	Ha Noi	Hue	Binh Dinh	Dak Lak	HCMC	Can Tho	Total
Urban men										
Work	Not active	20.9%(32)	45.2%(354)	75.3%(87)	48.0%(158)	35.5%(44)	32.4%(272)	77.3%(419)	57.7%(110)	62.4%(1440)
	Active: mean(SE)	147.0(14.9)	118.7(27.3)	53.5(8.9)	86.0(8.7)	141.8(9.4)	148.1(19.8)	158.8(16.8)	80.0(11.6)	114.9(6.0)
	Overall: mean(SE)	105.8(12.9)	3.5(2.2)	0.0(0.0)	2.0(0.5)	68.1(6.5)	60.0(11.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
Transport	Not active	41.3%(59)	47.4%(329)	72.0%(104)	68.7%(97)	48.7%(76)	62.9%(92)	76.6%(202)	35.6%(96)	63.1%(1434)
	Active: mean(SE)	48.7(3.0)	20.3(3.5)	17.8(2.1)	14.0(2.3)	20.0(3.1)	15.3(2.1)	20.2(2.0)	14.9(1.8)	19.9(0.9)
	Overall: mean(SE)	14.0(2.1)	4.7(0.8)	0.0(0.0)	0.0(0.0)	1.0(0.2)	0.0(0.0)	0.0(0.0)	6.7(0.6)	0.0(0.0)
Leisure	Not active	72.8%(118)	67.2%(221)	51.0%(163)	74.0%(209)	73.3%(156)	56.1%(312)	67.8%(278)	74.4%(194)	65.8%(1507)
	Active: mean(SE)	31.9(13.2)	28.6(5.4)	19.5(1.5)	15.0(2.0)	17.0(2.8)	17.6(2.5)	15.8(1.2)	14.0(1.7)	17.2(0.7)
	Overall: mean(SE)	0.0(0.0)	0.0(0.0)	3.0(0.3)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
Total	Not active	7.5%(8)	15.2%(114)	27.1%(23)	25.2%(44)	9.1%(18)	7.9%(65)	41.6%(81)	17.3%(30)	27.0%(564)
	Active: mean(SE)	155.9(18.5)	81.0(12.5)	30.0(1.9)	61.0(8.5)	113.0(8.4)	115.0(13.8)	38.2(4.2)	43.6(4.8)	48.0(2.3)
	Overall: mean(SE)	148.0(14.2)	46.0(14.3)	18.0(1.3)	28.0(3.0)	98.0(7.6)	100.1(11.8)	10.5(1.2)	28.7(2.1)	24.5(1.1)
Meet WHO recommendations		90.3%(148)	75.0%(297)	60.3%(188)	61.9%(194)	85.1%(174)	87.7%(248)	49.1%(392)	69.2%(211)	63.2%(1568)
Sedentary	mean(SE)	4.4(0.2)	4.5(0.4)	7.0(0.3)	4.3(0.2)	2.8(0.1)	2.4(0.2)	3.0(0.1)	1.9(0.1)	3.4(0.1)
Rural men										
Work	Not active	6.2%(46)	7.2%(131)	46.2%(213)	35.3%(248)	30.2%(52)	14.6%(395)	51.4%(184)	50.9%(256)	36.5%(1104)
	Active: mean(SE)	258.0(12.5)	207.8(16.1)	95.9(10.4)	119.2(9.3)	175.2(7.3)	223.6(12.5)	188.0(31.7)	74.8(8.5)	141.4(5.2)
	Overall: mean(SE)	242.4(9.3)	192.0(18.0)	4.0(1.4)	26.1(3.4)	106.1(4.9)	183.3(7.9)	8.0(2.2)	2.7(0.5)	36.1(2.2)
Transport	Not active	40.0%(266)	22.0%(155)	64.7%(310)	58.6%(164)	50.9%(202)	32.7%(166)	67.4%(114)	37.8%(290)	50.2%(1720)
	Active: mean(SE)	33.1(3.9)	23.6(2.7)	18.3(3.3)	15.5(1.5)	26.7(1.9)	20.3(1.0)	24.1(3.3)	14.0(1.5)	19.1(1.1)
	Overall: mean(SE)	14.0(1.8)	16.0(2.1)	0.0(0.0)	0.0(0.0)	2.0(0.2)	10.5(0.8)	0.0(0.0)	5.3(0.6)	3.0(0.2)
Leisure	Not active	92.3%(739)	81.3%(157)	62.3%(539)	83.8%(385)	82.1%(845)	76.0%(472)	78.8%(228)	79.8%(655)	78.0%(3603)
	Active: mean(SE)	20.3(4.9)	22.3(7.5)	19.6(2.3)	14.0(0.0)	15.7(1.8)	20.1(3.3)	18.2(3.6)	14.6(1.7)	17.0(0.0)
	Overall: mean(SE)	0.0(0.0)	0.2(0.0)	0.0(0.1)	0.0(0.0)	0.9(0.3)	0.0(0.0)	0.0(0.0)	0.2(0.0)	0.0(0.0)
Total	Not active	1.8%(12)	3.6%(43)	19.0%(77)	22.5%(72)	10.1%(15)	2.8%(121)	37.8%(48)	16.3%(122)	16.6%(431)
	Active	281.4(11.1)	241.1(18.2)	72.5(9.4)	111.7(8.9)	157.9(5.4)	212.2(7.7)	144.0(13.3)	49.7(3.9)	122.1(3.6)
	Overall: mean(SE)	265.3(12.4)	233.1(19.6)	33.4(8.7)	53.0(5.0)	137.7(4.4)	205.8(7.8)	38.7(7.4)	28.7(4.3)	72.7(3.4)
Meet WHO recommendations		96.5%(777)	94.9%(207)	72.3%(558)	70.3%(348)	87.2%(855)	93.8%(339)	61.7%(280)	71.2%(607)	77.0%(3801)
Sedentary	mean(SE)	3.6(0.1)	3.1(0.3)	5.9(0.3)	3.9(0.1)	3.1(0.1)	2.0(0.1)	2.8(0.2)	2.2(0.1)	3.4(0.1)

		Thai Nguyen	Hoa Binh	Ha Noi	Hue	Binh Dinh	Dak Lak	HCMC	Can Tho	Total
Urban women										
Work	Not active	21.0%(56)	51.7%(146)	77.7%(554)	65.3%(53)	43.0%(70)	37.7%(61)	90.0%(205)	72.2%(725)	72.0%(1906)
	Active: mean(SE)	94.0(18.8)	97.1(9.9)	56.0(5.9)	42.5(6.9)	85.2(10.8)	86.8(13.7)	87.4(10.7)	21.0(2.9)	60.0(3.1)
	Overall: mean(SE)	56.0(13.5)	0.0(0.2)	0.0(0.0)	0.0(0.0)	13.0(3.6)	42.5(9.9)	0.0(0.0)	0.0(0.0)	0.0(0.0)
Transport	Not active	42.3%(54)	40.6%(181)	45.2%(518)	41.5%(92)	39.2%(51)	47.6%(71)	59.5%(125)	23.2%(458)	46.3%(1171)
	Active: mean(SE)	34.8(4.0)	20.9(4.4)	14.8(1.2)	18.8(1.1)	20.5(1.7)	16.5(2.0)	14.0(1.6)	16.7(1.1)	15.8(0.7)
	Overall: mean(SE)	10.0(1.7)	9.1(1.6)	4.0(0.3)	8.0(0.7)	8.6(0.8)	5.3(0.8)	0.0(0.0)	9.3(0.9)	4.0(0.2)
Leisure	Not active	79.7%(77)	76.3%(202)	56.3%(428)	75.2%(89)	76.1%(103)	64.8%(104)	70.3%(237)	83.0%(518)	70.6%(1902)
	Active: mean(SE)	35.0(8.0)	13.3(1.9)	16.3(1.0)	17.0(2.0)	16.4(1.9)	16.1(2.1)	12.1(0.9)	19.2(1.4)	14.9(0.7)
	Overall: mean(SE)	0.2(0.1)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
Total	Not active	10.6%(20)	24.4%(63)	19.8%(278)	24.4%(14)	13.0%(27)	8.4%(13)	42.4%(72)	16.6%(306)	26.4%(612)
	Active	111.6(19.0)	69.1(13.8)	28.0(1.6)	34.6(4.0)	73.9(8.6)	69.5(10.8)	23.3(1.8)	25.7(1.7)	29.5(1.1)
	Overall: mean(SE)	84.7(20.5)	46.5(9.7)	20.5(1.1)	23.9(2.1)	56.0(7.6)	64.1(11.7)	7.0(0.5)	21.0(1.4)	15.0(0.7)
Meet WHO recommendations		86.0%(86)	69.2%(185)	64.8%(346)	67.2%(124)	78.6%(106)	84.2%(139)	45.1%(216)	64.7%(412)	61.0%(1898)
Sedentary	mean(SE)	4.0(0.3)	5.1(0.3)	6.8(0.2)	4.1(0.2)	2.7(0.1)	2.6(0.2)	3.2(0.2)	1.7(0.1)	3.5(0.1)
Rural women										
Work	Not active	6.6%(82)	13.3%(188)	50.7%(82)	49.5%(114)	33.5%(106)	20.0%(164)	90.4%(343)	68.7%(142)	49.1%(1642)
	Active: mean(SE)	168.0(7.7)	194.0(29.4)	63.9(7.6)	84.1(4.7)	145.4(4.9)	151.6(7.8)	153.5(18.4)	39.5(4.4)	95.5(3.4)
	Overall: mean(SE)	158.4(7.7)	167.6(27.4)	0.7(0.2)	14.0(1.1)	79.2(4.2)	115.3(7.2)	0.0(0.0)	0.0(0.0)	2.5(0.2)
Transport	Not active	28.7%(196)	14.9%(300)	35.7%(94)	37.5%(235)	39.9%(143)	31.2%(203)	51.6%(242)	30.3%(87)	34.8%(1447)
	Active: mean(SE)	27.0(2.3)	28.0(1.8)	18.7(1.4)	20.0(1.6)	24.5(1.1)	22.1(2.1)	16.2(2.4)	14.0(1.2)	18.8(0.6)
	Overall: mean(SE)	13.3(1.1)	21.0(2.0)	9.1(0.6)	8.7(0.8)	9.3(0.6)	12.1(0.8)	0.0(0.2)	8.0(0.5)	9.6(0.3)
Leisure	Not active	92.9%(650)	91.0%(475)	70.3%(115)	89.1%(543)	86.9%(818)	81.4%(661)	85.2%(614)	85.3%(132)	83.5%(4425)
	Active: mean(SE)	19.7(0.0)	12.9(0.0)	15.9(2.0)	15.5(1.2)	12.2(1.2)	18.7(3.0)	14.9(0.0)	11.2(0.9)	14.0(0.0)
	Overall: mean(SE)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)	0.0(0.0)
Total	Not active	2.0%(30)	7.5%(120)	16.4%(52)	22.7%(25)	16.3%(48)	4.6%(31)	40.2%(141)	22.0%(68)	18.3%(594)
	Active	190.1(10.8)	219.7(32.8)	55.9(5.7)	70.3(3.3)	136.8(5.1)	145.2(7.4)	20.5(2.7)	24.5(1.7)	59.3(1.8)
	Overall: mean(SE)	185.0(9.6)	189.3(29.9)	40.7(3.7)	44.3(2.8)	106.2(4.4)	136.4(7.5)	3.0(0.7)	14.2(1.1)	40.0(1.3)
Meet WHO recommendations		96.3%(731)	90.4%(408)	75.1%(93)	71.1%(679)	79.2%(804)	92.7%(720)	49.2%(505)	58.6%(83)	72.7%(4193)
Sedentary	mean(SE)	3.5(0.1)	3.5(0.1)	5.0(0.3)	3.8(0.1)	3.1(0.1)	2.1(0.1)	3.2(0.2)	1.9(0.1)	3.2(0.1)

Mean (standard error, SE) estimated with a shifted Box-Cox power transformation.

Additional Table 5.A.4. Correlations of the provincial proportion of inactive persons and mean (MET-hours/week) values of physical activity domains and total PA with the provincial proportion of urban population, minority ethnicity, the average annual rainfall, the latitude, the altitude, and the average temperature

	Men				Women			
	Work		Total		Work		Total	
	Inactive (%)	MET-hours	Inactive (%)	MET-hours	Inactive (%)	MET-hours	Inactive (%)	MET-hours
Urban population	0.91	–0.78	0.86	–0.79	0.93	–0.77	0.84	–0.82
Minority ethnicity	–0.59	0.63	–0.47	0.63	–0.53	0.71	–0.38	0.72
Annual rainfall	0.25	–0.41	0.37	–0.38	0.26	–0.39	0.40	–0.34
Latitude	–0.50	0.45	–0.40	0.48	–0.57	0.49	–0.49	0.57
Altitude	–0.33	0.37	–0.37	0.33	–0.33	0.28	–0.39	0.23
Average temperature	0.65	–0.55	0.65	–0.56	0.70	–0.54	0.76	–0.60

MET-hours per week estimated with a shifted Box-Cox transformation.

Additional Table 5.A.5. Estimates* of physical activity (MET-hours/week) with and without adjustment for seasonal variation in five provinces where measurement occurred in both wet and dry seasons, and overall eight provinces

	Hoa Binh		Ha Noi		Binh Dinh		Dak Lak		Can Tho		Total	
		Adjusted		Adjusted		Adjusted		Adjusted		Adjusted		Adjusted
Men												
Work	192.0	192.0	0.0	0.0	112.0	112.0	192.0	192.0	2.3	2.7	13.0	13.0
Transport	16.0	16.0	0.0	0.0	1.9	1.9	8.0	8.0	6.0	6.3	0.0	0.0
Leisure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	238.0	238.0	27.0	25.8	134.0	144.0	206.0	216.0	28.7	28.7	52.0	52.0
Women												
Work	168.0	168.0	0.0	0.0	66.0	82.8	120.0	120.0	0.0	0.0	0.0	0.0
Transport	18.7	18.7	9.3	9.3	9.3	9.9	12.0	12.0	9.3	9.3	9.3	9.3
Leisure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	189.3	189.3	34.7	32.0	110.0	112.5	131.0	131.0	16.8	15.7	28.0	28.0
Urban												
Work	3.5	3.5	0.0	0.0	48.0	62.3	56.0	56.0	0.0	0.0	0.0	0.0
Transport	9.3	8.4	0.0	0.0	7.5	9.0	4.0	4.0	7.5	7.5	0.0	0.0
Leisure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	56.0	56.0	18.7	18.7	91.0	117.0	105.0	105.0	24.0	24.0	21.0	21.0
Rural												
Work	192.0	192.0	0.7	0.7	100.0	106.2	188.0	188.0	0.0	0.0	16.0	16.0
Transport	16.0	16.0	4.7	4.7	8.0	7.6	12.0	12.0	7.7	7.7	7.3	7.2
Leisure	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	237.7	238.0	40.7	40.7	132.3	132.3	192.0	196.0	21.0	21.0	53.5	52.0

*Medians of cluster medians.

Additional Table 5.A.6. Factors associated with the number of errors (item non-response and implausible, or improbable responses) in reporting physical activity in response to core questions in GPAQ

	Men		Women	
	%(n/N)*	PR(95%CI)†	%(n/N)*	PR(95%CI)†
Sex	21.2% (1680/6743)	1.00	9.5% (975/7861)	0.44(0.39,0.51)
Age groups				
25–34 years	23.4%(470/1415)	1.00	8.8%(266/1735)	1.00
35–44 years	25.6%(525/1644)	1.10(0.92,1.31)	12.9%(316/1911)	1.48(1.13,1.92)
45–54 years	16.4%(404/1775)	0.70(0.59,0.84)	9.2%(267/2137)	1.05(0.78,1.41)
55–64 years	11.7%(281/1909)	0.50(0.39,0.65)	4.0%(126/2078)	0.45(0.32,0.64)
Trend		p<0.001		p=0.005
Residential areas				
Urban–Single job	12.0%(267/2295)	1.00	3.8%(116/2753)	1.00
Urban–Dual job	51.8%(23/60)	4.32(2.83,6.59)	37.7%(22/60)	9.80(5.84,16.43)
Rural–Single job	22.3%(1181/3983)	1.86(1.56,2.22)	10.5%(717/4730)	2.72(2.09,3.55)
Rural–Dual job	49.2%(209/405)	4.10(3.37,4.99)	33.8%(120/316)	8.80(6.35,12.17)
Interaction		p=0.004		p<0.001
Ethnicity				
Kinh	19.3%(1112/5569)	1.00	8.5%(597/6571)	1.00
Non-Kinh	53.4%(567/1157)	2.77(2.37,3.24)	27.6%(378/1277)	3.26(2.38,4.47)
P-value		p<0.001		p<0.001
Education levels				
<Primary	26.9%(316/1041)	1.00	8.2%(244/2157)	1.00
Primary	26.2%(526/1804)	0.98(0.79,1.20)	10.9%(305/2097)	1.33(1.00,1.76)
Secondary	21.9%(550/2042)	0.81(0.66,1.01)	11.6%(300/1930)	1.42(1.07,1.89)
Senior secondary	15.0%(174/936)	0.56(0.42,0.75)	8.4%(77/846)	1.03(0.69,1.53)
College/University+	10.4%(109/901)	0.39(0.29,0.52)	5.5%(48/814)	0.67(0.43,1.07)
Trend		p<0.001		p=0.164
Monthly income‡				
<20 USD	32.4%(422/1209)	1.00	17.5%(309/1475)	1.00
20−40 USD	23.8%(418/1439)	0.74(0.62,0.88)	11.7%(239/1628)	0.67(0.52,0.86)
41−60 USD	22.5%(250/1148)	0.70(0.56,0.86)	9.0%(134/1316)	0.52(0.39,0.69)
61−80 USD	19.4%(126/507)	0.60(0.45,0.79)	8.3%(44/520)	0.48(0.29,0.79)
81+ USD	15.4%(247/1442)	0.48(0.38,0.59)	6.4%(116/1615)	0.37(0.27,0.50)
Trend		p<0.001		p<0.001

* Weighted percentages (unweighted number of respondents with reporting errors/total number of respondents in this category).

† PR(95 %CI): prevalence ratios (95% confidence interval).

‡ Monthly household income per adult member.

Additional Table 5.A.7. Summary of the work activities of respondents who reported having two types of work activities

	Men	Women
First type of work activity		
Numbers of months spent per year: mean(SE)*	7.0(0.1)	7.3(0.1)
Work activity (MET-hours/week): mean(SE)*	127.7(4.4)	92.0(2.9)
Total activity (MET-hours/week): mean(SE)*	156.6(4.6)	124.7(3.2)
Job description		
Farming	62.0%(315/465)	74.0%(281/375)
Selling lottery tickets	0.7%(4/465)	0.0%(0/375)
House keeping	0.0%(0/465)	3.7%(11/375)
Working in a factory	6.0%(15/465)	1.9%(7/375)
Selling goods (general)	1.6%(7/465)	6.9%(19/375)
Working as required	4.4%(10/465)	0.0%(0/375)
Construction	14.5%(48/465)	4.3%(13/375)
Feeding and taking care of animals	5.0%(36/465)	4.6%(23/375)
Others	5.8%(30/465)	4.6%(21/375)
Second type of work activity		
Numbers of months spent per year: mean(SE)*	5.0(0.1)	4.7(0.1)
Work activity (MET-hours/week): mean(SE)*	365.5(0.0)	285.2(0.0)
Total activity (MET-hours/week): mean(SE)*	383.7(0.0)	311.0(0.0)
Job description		
Farming	27.5%(142/465)	27.0%(98/375)
Selling lottery tickets	1.2%(6/465)	0.0%(0/375)
House keeping	0.8%(16/465)	17.1%(69/375)
Working in a factory	2.4%(7/465)	4.6%(11/375)
Selling goods (general)	7.3%(18/465)	9.9%(29/375)
Working as required	12.7%(68/465)	10.4%(61/375)
Construction	23.8%(107/465)	6.3%(21/375)
Feeding and taking care of animals	11.9%(56/465)	13.9%(47/375)
Others	12.3%(45/465)	10.8%(39/375)

*Mean (standard error, SE) estimated with a shifted Box-Cox transformation.

Chapter 6. Fruit and vegetable consumption in Vietnam, and the use of 'standard serving' size to measure intake

6.1. Preface

Additional information on the mean levels and prevalence of three major modifiable lifestyle risk factors (tobacco use, alcohol consumption *and* physical activity) has been presented in previous chapters. Issues pertaining to the validity of the measurements of these risk factors have been investigated. In this chapter, additional data on the measurements of fruit and vegetable intake using the STEPS instrument will be provided, and the construct validity of data collected will be assessed. The contents of this chapter have been conditionally accepted for publication in the *British Journal of Nutrition.*

6.2 Introduction

Low fruit and vegetable consumption was among the top 20 risk factors contributing to the global burden of disease in 2010 (1). Inadequate intake of fruit and vegetable was estimated to be responsible for nearly 14% of gastrointestinal cancer, 11% of ischaemic heart disease, 9% of stroke deaths and approximately 3% of overall mortality worldwide (2). Global data show that more than three-quarters of the world population consume less than the WHO recommendation of at least five servings of fruit and vegetables per day (3). Rapid urbanisation, rising incomes and an increase in fast food consumption have reportedly led to a decreased consumption of fruit and vegetables in developing countries (4).

Common methods used to assess food consumption include dietary records, 24-hour dietary recall, food frequency questionnaires (FFQs) and dietary history (5, 6). However, using these instruments can be time consuming and unwarranted in situations that do not require assessment of the total diet. Many brief dietary instruments for assessments of specific dietary components, such as fruit and vegetables, have been developed for use in population surveillance to monitor national and regional trends in consumption over time, and to evaluate interventions intended to modify intake for the primary prevention of chronic diseases (5, 6).

Brief questions have been shown to provide a valid measure of fruit and vegetable intake (7). Two simple questions on fruit and vegetable consumption were used in the World Health Survey (3), and four simple questions were included in the STEPS questionnaire to collect information on the number of standard servings of fruit and vegetable per day in a typical week (8). A ‘standard serving’ size was used to standardise measurement because validation studies of brief instruments in the United States suggested that actual fruit and vegetable intake was underestimated without portion size adjustments (9-11). In Vietnam, information on fruit and vegetable intake has been reported in a national nutrition survey (12) conducted during 2009−10 using the 24-hour recall method. The STEPS questionnaire has been used to collect fruit and vegetable data in studies conducted in the cities of Ha Noi (13) and Can Tho (14) in 2005, but the validity of data collected has not been tested.

Taking advantage of the data from a nationally-representative survey of NCD risk factors, the principal aim of this study was to provide national estimates of fruit and vegetable consumption in Vietnam. The secondary aim was to investigate whether or not fruit and vegetable intake reported in ‘standard serving’ sizes have evidence of construct validity.

6.3 Methods

6.3.1 Study participants

The data used for this analysis were from a population-based survey of risk factors for non-communicable disease in Vietnam in 2009−10 that was designed in accordance with the STEPS methodology (8). Eligible subjects were persons aged 25−64 years living at a residential address in each selected commune, town, or city ward of eight provinces (Thai Nguyen, Hoa Binh, Ha Noi, Hue, Binh Dinh, Dak Lak, Ho Chi Minh City and Can Tho) each representative of one of the eight geographical regions of Vietnam. The two-stage sampling procedure involved selecting 20 clusters (communes, towns, and city wards) from each of the eight geographically-representative provinces with probabilities proportional to population size from four strata defined by urban-rural location and rich-poor classification. For each selected cluster, the provincial health authority prepared a comprehensive listing of residents aged 25−64 years. From those lists, persons were selected by age and sex stratified random sampling. Of the 22,940 eligible subjects aged 25–64 years, 14,706 participated (response proportion 64.1%). The details have been presented elsewhere (15). The protocol of this survey was approved by the Ethics Committee of the Vietnam Ministry of Health and the Tasmanian Health and Medical Human Research Ethics Committee. Informed consent was obtained from participants.

6.3.2 Measurements

Information on fruit and vegetable consumption was collected using four simple questions included in the WHO STEPS questionnaire (8). The questionnaire was translated into Vietnamese and back-translated by independent translators to ensure the appropriate meaning of each item was retained. Face-to-face interviews were conducted with participants by trained staff of each provincial health authority. The participants were asked about the number of days they usually ate fruit, and the number of days they usually ate vegetables (excluding root plants), in a typical week and how many 'standard serving' sizes they usually ate of each on those days. A 'standard serving' size of fruit or vegetables was defined as a cup of raw fruit/vegetable, a ½ cup of cooked fruit/vegetable, or a ½ cup of fruit/vegetable juice, and assumed to correspond to 80 grams (8). Visual aids (see Appendix 8) depicting a 'standard serving' size of fruit and vegetables were used to facilitate interviewing (8). Measurements of socio-demographic characteristics, other behavioural risk factors, and body size/fatness including weight, height, and waist and hip circumference, were made according to the standardized STEPS procedures (8). Body mass index (BMI) was calculated as weight ÷ height^2 and categorised as under-weight, normal weight, overweight and obese according to cut-points for Asian populations (16).

6.3.3 Data analysis

The daily consumption of fruit and vegetable was estimated separately for fruit and vegetables by multiplying the typical weekly frequency of consumption of fruit and vegetables by the number of servings consumed per day and dividing it by seven. Low fruit and vegetable intake was defined as consuming less than five servings of fruit and vegetables per day (8). Non-missing data were re-weighted to account for missing data (17).

For individual level analyses, linear regression was used to estimate adjusted means of standard servings of fruit and vegetable consumed, and Poisson regression with robust standard errors (18) was used to estimate adjusted prevalence and ratios of prevalence of having at least five servings at different levels of socio-demographic factors. Tests of trend were undertaken by replacing multiple binary (0/1) covariates for the socio-demographic factors with a single ordinal covariate. Partial Pearson correlation coefficients were used to assess the associations between fruit/vegetable intake and body size/fatness. Age, income and alcohol consumption were adjusted for in each analysis. Other factors investigated as potential confounders were education, tobacco smoking and physical activity. Chi-squared analysis was used to compare distributions of fruit and vegetable intake. The analyses were performed using complex survey methods provided by Stata version 12.0.

At the aggregate level, Pearson correlation coefficients were used to summarise the associations between aggregate measures of fruit and vegetable consumption for each province (e.g. the provincial proportions of persons meeting the WHO recommendations for consuming at least 5 servings of fruit and vegetables daily) (19) and its demographic, geographical and climatic characteristics (including the proportion of each provincial population living in areas classified as urban). Wet season and dry season were defined as months with average rainfall > 60mm and ≤ 60mm respectively (20).

6.4 Results

Table 6.1 presents selected characteristics of participants, stratified by sex. Approximately 70% of the sample lived in rural areas. Men had higher proportions of high school completions, and were more active than women. Three-in-four men were tobacco smokers and two-in-five were hazardous/harmful drinkers. These behaviours were rare among women. Mean levels of BMI, waist circumference, waist to hip ratio (WHR), number of days when respondents consumed fruit and vegetables, number of daily servings of fruit, vegetables and fruit and vegetables combined, and the proportions of participants meeting the WHO recommendations, were generally similar between men and women, however. Both men and women consumed vegetables almost every day in a typical week, whereas fruit was consumed on only 3.2 days (men) and 4.0 days (women). On average, around 0.9 servings of fruit and 2.3 servings of vegetables were consumed daily, with no meaningful differences across sexes. Participants living in the northern provinces (Thai Nguyen, Hoa Binh and Ha Noi) had significantly higher intake of vegetables, and of fruit and vegetables combined, than did those in the southern provinces (Ho Chi Minh and Can Tho) (see Additional Table 6.B.1).

Table 6.1. Characteristics of subjects

Characteristic	Men	Women
Age: mean(SD)	40.5(10.2)	41.1(10.5)
Minority ethnicity (Non-Kinh)	5.8%(1161/6787)	5.4%(1283/7889)
Rural residential area	70.2%(4434/6804)	69.2%(5079/7902)
Education completed		
Less than high school	71.0%(4929/6785)	75.9%(6213/7885)
High school+	29.0%(1856/6785)	24.1%(1672/7885)
Monthly household income*		
<20 USD	15.4%(1214/5803)	14.9%(1479/6595)
20-39 USD	20.9%(1452/5803)	22.2%(1641/6595)
40-59 USD	23.4%(1164/5803)	22.7%(1322/6595)
60-79 USD	8.5%(514/5803)	8.1%(523/6595)
80+ USD	31.8%(1459/5803)	32.1%(1630/6595)
Smoking status		
Never smoker	25.1%(1723/6782)	97.4%(7551/7886)
Ex-smoker	17.2%(1347/6782)	0.9%(101/7886)
Current non-daily smoker	2.8%(166/6782)	0.1%(12/7886)
Current daily smoker	54.9%(3546/6782)	1.7%(222/7886)
Alcohol consumption†		
Low	59.3%(4147/6804)	31.1%(1811/7878)
Hazardous	16.6%(1104/6804)	27.8%(1937/7878)
Harmful	24.1%(1553/6804)	41.1%(4130/7878)
Physical activity‡		
Low	27.2%(1435/6786)	31.1%(1811/7878)
Moderate	20.8%(1298/6786)	27.8%(1937/7878)
High	52.0%(4053/6786)	41.1%(4130/7878)
Fruit intake		
Days per week: mean(SD)	3.4(2.5)	4.0(2.5)
Servings per day: mean(SD)	0.8(0.9)	0.9(0.9)
Vegetable intake		
Days per week: mean(SD)	6.2(1.7)	6.4(1.5)
Servings per day: mean(SD)	2.3(1.6)	2.3(1.4)
Fruit and vegetable intake		
Servings per day: mean(SD)	3.2(2.0)	3.2(1.9)
≥ 5 servings per day	18.3%(1117/6708)	18.2%(1416/7816)
Body size and fatness		
Body mass index: mean(SD)	21.5(3.1)	21.5(3.0)
Waist: mean(SD)	74.9(8.9)	72.0(8.6)
Waist-hip ratio: mean(SD)	0.9(0.1)	0.8(0.1)

* Monthly household income per adult member ($US).

† Hazardous drinking: ≥4 standard drinks (men) and ≥2 standard drinks (women) per drinking occasion during the last year, harmful drinking: ≥6 standard drinks (men) and ≥4 standard drinks (women) per drinking occasion during the last year.

‡ Low: <600 MET-minutes per week; Moderate: 600−3000 MET-minutes per week; High: >3000 MET-minutes per week.

Estimated proportions of the Vietnamese population meeting the daily recommended intake levels of fruit and vegetables are depicted in Figure 6.1. The proportions of respondents having daily consumption of at least two servings of fruit and three servings of vegetables were 16.7% and 32.2% respectively. Less than 20% of respondents reported having at least five servings of fruit and vegetables per day in a typical week. These estimates were similar for men and women (data not shown). The frequency distribution of the number of servings of fruit and of vegetables in each region of the country was similar for men and women. Additional Figure 6.A.1 shows this for fruit and vegetable consumption in the three northern-most and two southern-most provinces. The differences by sex for each food type (fruit, vegetable) and in each region are statistically significant ($p<0.001$) in this large sample, but they are less pronounced than the differences between food types and regions, and in most cases were minor and not statistically significant within strata of BMI (data not shown).

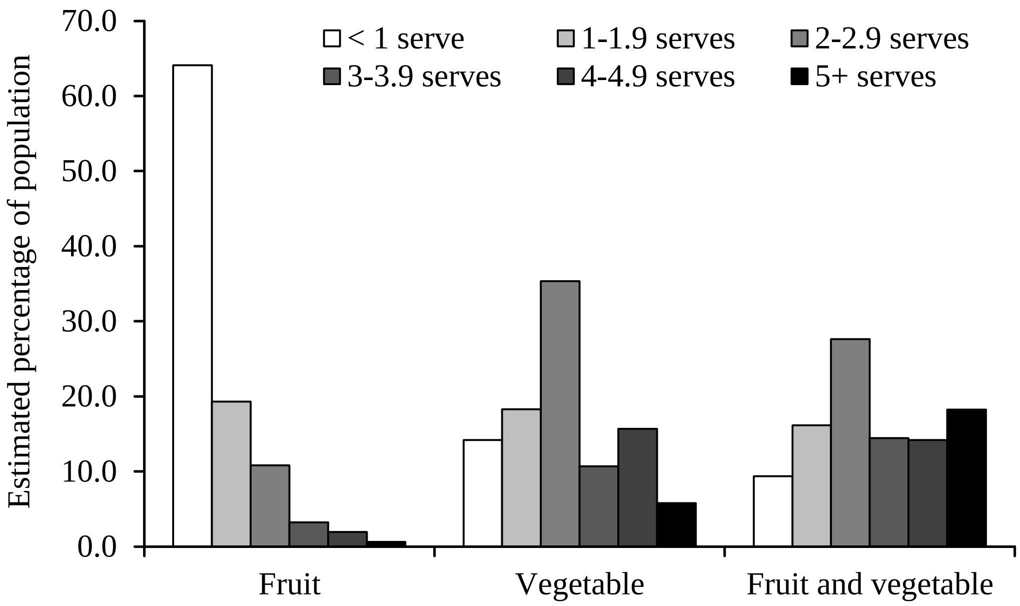

Figure 6.1. Estimated proportions of the Vietnamese population consuming fruit and vegetable per day in a typical week

Table 6.2 presents estimated associations between fruit and vegetable consumption and socio-demographic factors. Overall, respondents with higher levels of education and household income, and those living in urban areas, reported more consumption of fruit and of vegetables than those living in rural areas. There were similar findings for daily servings of fruit and vegetable combined (data not shown). Educational status, household income and residential area independently predicted both fruit consumption and vegetable consumption (data not shown).

Table 6.2. Factors associated with fruit and vegetable intake in individual level analyses

	Fruit	Vegetable	≥ 5 servings*		
	Mean(95%CI)	Mean(95%CI)	%	(n/N)†	PR‡(95%CI)
Men					
Age group					
25–34 years	0.85(0.77,0.93)	2.31(2.19,2.42)	17.6%	(225/1406)	1.00
35–44 years	0.81(0.74,0.89)	2.36(2.25,2.47)	19.7%	(295/1643)	1.12(0.88,1.42)
45–54 years	0.78(0.72,0.84)	2.34(2.21,2.47)	17.6%	(285/1769)	1.00(0.78,1.28)
55–64 years	0.83(0.76,0.90)	2.24(2.14,2.35)	17.8%	(312/1890)	1.01(0.80,1.28)
Trend	p=0.321	p=0.787			p=0.983
Ethnicity§					
Kinh	0.82(0.77,0.86)	2.32(2.25,2.38)	18.2%	(944/5551)	1.00
Non-Kinh	0.91(0.76,1.06)	2.52(2.23,2.81)	19.7%	(169/1140)	1.08(0.77,1.52)
P-value	p=0.243	p=0.176			p=0.551
Residential areas§					
Urban	0.94(0.88,0.99)	2.28(2.18,2.37)	20.9%	(478/2344)	1.00
Rural	0.77(0.72,0.83)	2.34(2.27,2.42)	17.1%	(639/4364)	0.82(0.70,0.96)
P-value	p<0.001	p=0.289			p=0.013
Education levels§					
<Primary	0.62(0.51,0.72)	1.96(1.85,2.08)	11.1%	(102/1021)	1.00
Primary	0.71(0.64,0.78)	2.21(2.07,2.35)	15.4%	(225/1802)	1.39(0.94,2.06)
Secondary	0.83(0.76,0.89)	2.28(2.17,2.39)	16.7%	(335/2026)	1.51(1.13,2.01)
Senior secondary	0.94(0.85,1.04)	2.50(2.32,2.68)	21.3%	(187/933)	1.92(1.39,2.66)
College/University+	1.12(1.04,1.19)	2.84(2.63,3.05)	31.2%	(268/907)	2.82(2.07,3.84)
Trend	p<0.001	p<0.001			p<0.001
Monthly income§¶					
<20 USD	0.60(0.51,0.69)	2.00(1.88,2.13)	9.6%	(141/1199)	1.00
20−40 USD	0.82(0.72,0.91)	2.22(2.10,2.34)	15.0%	(209/1440)	1.57(1.15,2.14)
41−60 USD	0.78(0.71,0.85)	2.47(2.30,2.65)	18.5%	(191/1149)	1.94(1.38,2.74)
61−80 USD	0.85(0.71,0.98)	2.27(2.08,2.47)	15.9%	(95/505)	1.68(1.10,2.56)
81+ USD	1.02(0.94,1.10)	2.82(2.70,2.94)	28.4%	(379/1443)	3.00(2.20,4.09)
Trend	p<0.001	p<0.001			p<0.001
Women					
Age group					
25–34 years	0.96(0.89,1.03)	2.31(2.20,2.42)	19.3%	(322/1731)	1.00
35–44 years	0.95(0.88,1.01)	2.27(2.17,2.37)	18.8%	(366/1912)	0.98(0.78,1.22)
45–54 years	0.86(0.80,0.92)	2.22(2.11,2.32)	16.9%	(389/2120)	0.87(0.71,1.08)
55–64 years	0.85(0.79,0.91)	2.11(2.01,2.22)	16.4%	(339/2053)	0.85(0.68,1.06)
Trend	p=0.006	p=0.021			p=0.093
Ethnicity§					
Kinh	0.92(0.88,0.95)	2.23(2.18,2.29)	18.1%	(1129/6535)	1.00
Non-Kinh	0.92(0.82,1.02)	2.63(2.34,2.92)	20.2%	(283/1268)	1.10(0.81,1.50)
P-value	p=0.976	p=0.007			p=0.435
Residential areas§					
Urban	1.19(1.14,1.25)	2.28(2.22,2.35)	24.8%	(667/2801)	1.00
Rural	0.80(0.75,0.84)	2.24(2.16,2.31)	15.3%	(749/5015)	0.62(0.53,0.72)
P-value	p<0.001	p=0.385			p<0.001

Education levels§				
<Primary	0.61(0.54,0.68)	1.87(1.78,1.95)	8.8%(198/2124)	1.00
Primary	0.82(0.76,0.88)	2.18(2.09,2.28)	14.4%(307/2083)	1.64(1.17,2.30)
Secondary	0.96(0.88,1.05)	2.40(2.28,2.52)	18.9%(389/1928)	2.15(1.58,2.94)
Senior secondary	1.19(1.10,1.27)	2.42(2.27,2.57)	26.5%(212/843)	3.03(2.13,4.32)
College/University+	1.39(1.28,1.51)	2.70(2.54,2.86)	36.1%(308/821)	4.14(3.12,5.50)
Trend	p<0.001	p<0.001		p<0.001
Monthly income§¶				
<20 USD	0.61(0.55,0.68)	2.09(1.96,2.21)	10.1%(215/1467)	1.00
20−40 USD	0.70(0.65,0.76)	2.15(2.05,2.25)	12.4%(229/1623)	1.24(0.91,1.69)
41−60 USD	0.89(0.82,0.96)	2.32(2.18,2.47)	18.6%(243/1317)	1.86(1.39,2.49)
61−80 USD	1.04(0.93,1.15)	2.32(2.17,2.48)	18.7%(109/517)	1.87(1.29,2.72)
81+ USD	1.25(1.18,1.32)	2.61(2.50,2.72)	28.7%(477/1626)	2.89(2.16,3.86)
Trend	p<0.001	p<0.001		p<0.001

* ≥ five servings of fruit and vegetables per day in a typical week.
† Weighted percentages (unweighted number of respondents/total number of respondents in this category).
‡ PR(95 %CI): prevalence ratio (95% confidence interval).
§ Ethnicity, residential areas, education levels, and income are adjusted for age.
¶ Monthly household income per adult member.

Estimated associations of fruit and vegetable intake with body size/fatness are presented in Table 6.3. Consumption of fruit, vegetables or fruit and vegetables combined was positively and significantly correlated with BMI, waist circumference, and WHR for both men and women. There were stronger correlations of fruit and vegetable indicators with body size/fatness for women. Rank correlation coefficients were generally similar to Pearson correlation coefficients (data not shown).

The correlations between summary values of fruit/vegetable indicators and socio-demographic, geographical and climatic factors of each province are summarised in Table 6.4. Provincial mean servings of fruit, vegetables and fruit plus vegetables were correlated with proportions of urban population and with the latitude and climate of each province. The relatively low vegetable consumption and relatively high fruit consumption in the highly urbanised southern-most provinces of Can Tho and Ho Chi Minh, and the relatively high vegetable consumption in the more temperate northern provinces (Thai Nguyen, Ha Noi and Hoa Binh), were influential in producing these associations. They are depicted in Additional Figure 6.A.2.

Table 6.3. Correlation† of self-reported fruit and vegetable consumption with body sizes and fatness in individual analysis

	Men	Women
Body mass index		
Fruit‡	0.067***	0.111***
Vegetable‡	0.052***	0.060***
Fruit and vegetable‡	0.062***	0.100***
≥ 5 servings§	0.026*	0.084***
Waist		
Fruit‡	0.069***	0.153***
Vegetable‡	0.066***	0.086***
Fruit and vegetable‡	0.074***	0.135***
≥ 5 servings§	0.024	0.123***
Waist to hip ratio		
Fruit‡	0.039**	0.092***
Vegetable‡	0.042**	0.060***
Fruit and vegetable‡	0.047***	0.088***
≥ 5 servings§	0.013	0.084***

*p<0.05, **p<0.01, ***p<0.001.
† Partial Pearson correlation adjusted for age, income and alcohol consumption.
‡ Number of servings per day in a typical week.
§ ≥ 5 servings of fruit and vegetables per day in a typical week.

The summary values were inversely associated with the proportion of respondents interviewed in the wet season. This brought into question the seasonal timing of the survey. Overall, 92.1% (12,924/14,706) of respondents were interviewed in the wet season. For five provinces, we were able to compare fruit/vegetable intake for those interviewed in the wet season and those in the same province interviewed in the dry season. The proportions of interviews conducted in the wet season for Hoa Binh, Ha Noi, Binh Dinh, Dak Lak and Can Tho were 97.0% (1758/1902), 93.8% (1566/1643), 45.6% (772/1911), 88.8% (1509/1809) and 90.3% (1592/1714) respectively. The mean servings of fruit in these five provinces were 0.83 (wet season) and 0.80 (dry season). The mean servings of vegetables were 2.29 (wet season) and 2.09 (dry season). The results of re-scaling the dry season values for fruit/vegetables to have the same median in each age, sex and urban/rural stratum as the wet season values are shown in the Additional Table 6.B.2. The impacts were negligible on the national estimates, but of consequence for the estimates for provinces where respondents were interviewed in the dry season.

Table 6.4. Correlations of the summary measures of fruit and vegetable consumption for each of the eight provinces with provincial mean values of the demographic, geographical and climatic factors

	Men				Women			
	Fruit*	Veg*	Fruit-veg*	≥ 5 servings†	Fruit*	Veg*	Fruit-veg*	≥ 5 servings†
Urban population‡	0.30	–0.31	–0.14	0.24	0.54	–0.37	–0.14	0.20
Latitude§	0.22	0.92	0.80	0.54	0.05	0.90	0.78	0.58
Annual rainfall¶	–0.09	0.27	0.18	0.30	–0.29	0.18	0.06	0.19
Average temperature**	0.20	–0.43	–0.27	0.05	0.21	–0.48	–0.34	–0.12
Wet season††	0.44	0.26	0.36	0.40	0.58	0.33	0.46	0.52

* Mean servings of fruit, vegetables, and fruit and vegetables combined.
† Proportion of respondents consuming at least five servings of fruit and vegetables per day.
‡ Proportion of respondents living in urban areas.
§ Latitude of the survey site of each province.
¶ Average rainfall of the survey site of each province.
**Average temperature of the survey site of each province.
†† Proportions of respondents were interviewed in the wet season (average rainfall > 60mm).

6.5 Discussion

One of the main findings of the present study is that Vietnamese people consume on average 0.87 servings of fruit and 2.29 servings of vegetables per day, with less than 20% of Vietnamese people aged 25−64 years meeting the WHO recommendations for a daily consumption of at least five standard servings of fruit and vegetables. The overall findings are broadly consistent with previous studies. Our mean servings of fruit and of vegetables were a little higher than, but generally similar to, the results of a national nutrition survey conducted in Vietnam during 2009–10 (12), which reported values of daily consumption around 60 grams (0.75 servings) of fruit and 155 grams (1.94 servings) of vegetable leaves (no cruciferous, marrow, stems, allium, or root plants). Our estimated proportions of respondents meeting dietary recommendations were lower than the results of a national survey conducted in Thailand in 2004 (25.4% of men, 27.7% of women) (21), and a little lower than those reported in a pooled analysis of 52 mainly developing countries (22.4% of men, 21.6% of women) (3). The proportions of the population reaching the recommended ≥ 2 servings for fruit were lower, but the proportions of the population meeting the recommended ≥ 3 servings of vegetables were higher, than those reported in Thai survey (21). Our estimated proportions of participants consuming at least five servings of fruit and vegetables for the sub-sample of Ha Noi (25.8% of men, 28.9% of women) were lower than those from a previous survey conducted in 2005 in Chililab community of Ha Noi (36.5% of men, 42.5% of women), but higher than those from another survey conducted in Filabavi community of Ha Noi (13% of men, 13% of women) (13). Our estimated proportions for the Can Tho sub-population (14.4% of men, 12.4% of women) were lower than those from a previous survey conducted in Can Tho in 2005 (30.2% of men, 26.5% of women) (14).

Between-country differences in urbanization were postulated to be a possible contributor to the variation in the country-specific proportions of participants meeting the WHO recommendations in the pool analysis of 52 mainly developing nations (3). We found considerable variation in proportions of respondents meeting dietary recommendations, but between the provinces of a single country (see Additional Table 6.B.2). The present findings showed that the proportions of respondents reaching the WHO recommendations were high in the highly urbanised provinces of Ha Noi and Can Tho. Our aggregate level analyses supported this point. Within-province differences in urbanization were also suggested as a potential explanation for the different estimates of proportions of participants meeting dietary recommendations in Chililab and Filabavi communities of Ha Noi (13). A second source of heterogeneity is differences in timing of the surveys given seasonal availabilities of fruit and vegetables. It is well known that fruit and vegetable consumption patterns display seasonal variability, with higher consumption in the harvest season (the wet season in the present study) (22). Our survey conducted in Can Tho was mainly in the dry season (March to August), whereas the 2005 Can Tho survey (14) – that produced higher estimates – was conducted in the wet season (July to November). Even though the Chililab and Filabavi surveys (13) and our survey were all conducted in Ha Noi at a similar time (June to November), the seasonal impacts on reporting may be variable because the monthly rainfall in Ha Noi varies substantially from year to year.

The second aim of this study was to investigate whether or not self-reported information on quantities of fruit and vegetable consumed in terms of standard serving sizes provides some evidence of construct validity. The associations between fruit/vegetable intake and place of residence, education and income are in line with the findings of previous surveys in other developing countries (3, 13, 21, 23, 24). Firstly, reported servings of fruit, fruit plus vegetables, and proportions of participants meeting the WHO recommendations, were higher in urban than in rural areas (21, 24). Although the majority of fruit and vegetables are cultivated in rural areas, they are transported to the markets in urban areas. Consequently, more fruit and vegetables are available to consumers in urban areas. Local markets in rural areas are more restricted in the variety of fruit and vegetables available for purchase (25). Respondents living in urban areas had higher levels of education and income than those living in rural areas (presented in Chapter 2 of this thesis), and our data support earlier findings in other developing countries (21, 23, 24) that fruit and vegetable intake increases with levels of education and household income, but the association between fruit/vegetable intake and place of residence was independent of education and income status. This finding in individual analyses is supported by our aggregate level analyses that provinces with higher proportions of urban population also had higher mean servings of fruit, and higher proportions of participants meeting the dietary recommendations, and is consistent with the results of previous studies (21, 26). There was a remarkable similarity in reported intake of fruit and of vegetables for men and women of the same region, and particularly for men and women of similar body size.

In further assessment of the construct validity of fruit/vegetable data reported in standard serving sizes, we examined the correlations between reported intake and body size/fatness. Somewhat unexpectedly, we found that reported servings of fruit, vegetable and fruit plus vegetables, as well as proportions of respondents who consumed at least five servings daily (women), were positively associated with body size/fatness. These associations were independent of age, income, education, alcohol consumption, tobacco use and physical activity, but the STEPS questionnaire (8) does not provide quantitative measures of total energy intake or even the energy intake of each food item. Only intake of fruit and vegetables was collected because the purpose of the STEPS methodology is to obtain small amounts of useful information on a regular and continuous basis when resources are limited. If those who ate more fruit and vegetables were also eating more of other high-energy foods, and total energy intake is a contributor to larger body size/fatness, adjusting for other energy sources would at least attenuate the positive associations found between fruit/vegetable consumption and body size/fatness and, if the cross-correlations with other energy sources were sufficiently strong, could unmask a protective association of fruit/vegetable consumption with body size/fatness (27).

The findings also reflect the demographic, geographic and climatic characteristics of the country. The present findings of higher mean servings of vegetables in three northern-most provinces (Thai Nguyen, Hoa Binh and Ha Noi) are consistent with the results of the national nutrition survey conducted in Vietnam (28). The survey results showed that vegetables form a larger part of the diet of persons living in the north than of those living in the south, where rice is an important component of diet. Also, our higher mean servings of fruit in the highly urbanised provinces of Ha Noi, Ho Chi Minh and Can Tho are generally in line with the results of this national nutrition survey (28). Collectively, plausible associations found at the individual and aggregate levels suggest that intake reported in standard servings had some evidence of construct validity.

The present study has several strengths. Firstly, the data were collected from a nationally-representative survey of the Vietnamese population. The large sample allowed analyses stratified by ecological location, and the availability of data on other behavioural risk factors for NCD made it possible to take account of putative modifying, confounding and mediating factors. Secondly, the interviews were conducted by trained staff in accordance with standardized WHO protocols designed to minimize random error and bias, and using a culturally-sensitive instrument that had been translated and back-translated. In addition, standardised serving sizes depicted by visual aids tailored to local types of fruit and vegetables were used in this survey to assist participants (6).

This investigation has some limitations, however. Firstly, whilst participation was high for a study with overnight fasting, blood sampling and nearly two hours of on-site attendance, the possibility of non-participation bias cannot be discounted. Information on fruit and vegetable consumption was self-reported. However, similar brief fruit and vegetable instruments have been validated and widely used in developed countries (29) and, in our study, the self-reported data had some evidence of construct validity. Secondly, information on fruit and vegetables was collected by provincial data collection teams, and inter-team measurement variation cannot be excluded as a contributing factor for part of the differences found between geographical regions. Thirdly, we found there was seasonal variation in the reporting of intake with higher mean values when reported in the wet season. This made almost no difference to our national estimates, because less than 10% (1782/14706) of respondents were interviewed in the dry season, but our data suggest that a survey conducted in Vietnam in the wet season could produce mean estimates 4% (fruit) or 10% (vegetables) higher than a survey conducted in the dry season. Clearly this is an issue to be considered when planning surveys.

6.6 Conclusions

In conclusion, approximately 80% of Vietnamese people aged 25−64 years did not meet WHO recommendations for daily consumption of at least five servings of fruit and vegetables. Self-reported information on quantities of fruit and vegetables consumed in terms of standard serving sizes had some evidence of construct validity, but with seasonal variation in reporting identified together with a limitation on the usefulness of the information for associative analyses.

6.7 Postscript

The research presented in this chapter has shown that whilst fruit and vegetable consumption in Vietnam is not low by international standards, it is the case that only one-in-five Vietnamese people consume at least five servings of fruit and vegetables each day as recommended by WHO. This chapter completes the assessment of mean levels or prevalence of risk factors for NCD in Vietnam, including the detailed assessment of four major lifestyle risk factors. The next chapter will summarise all of the findings, discuss their implications, and identify the future directions of research.

6.8 References

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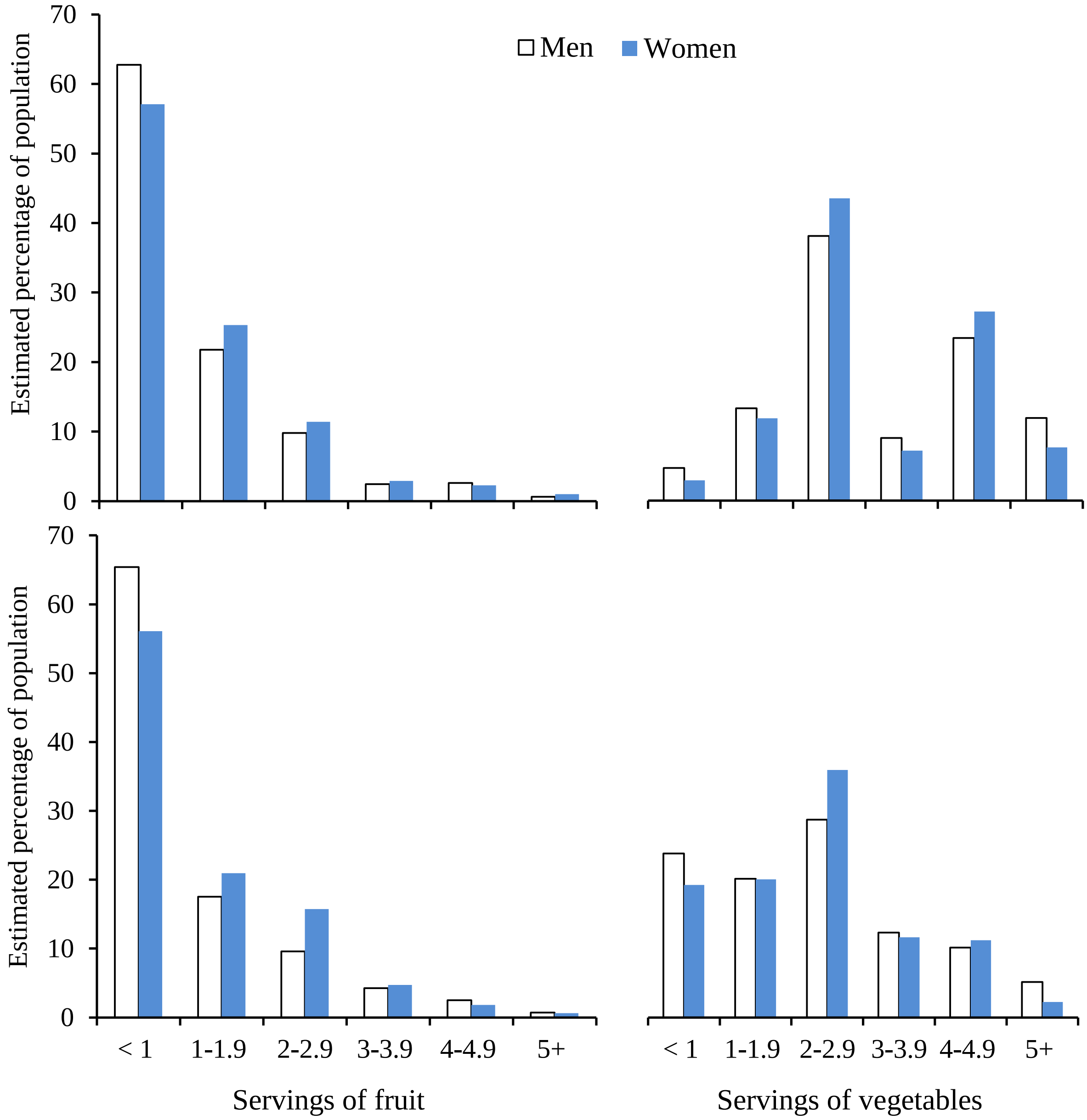
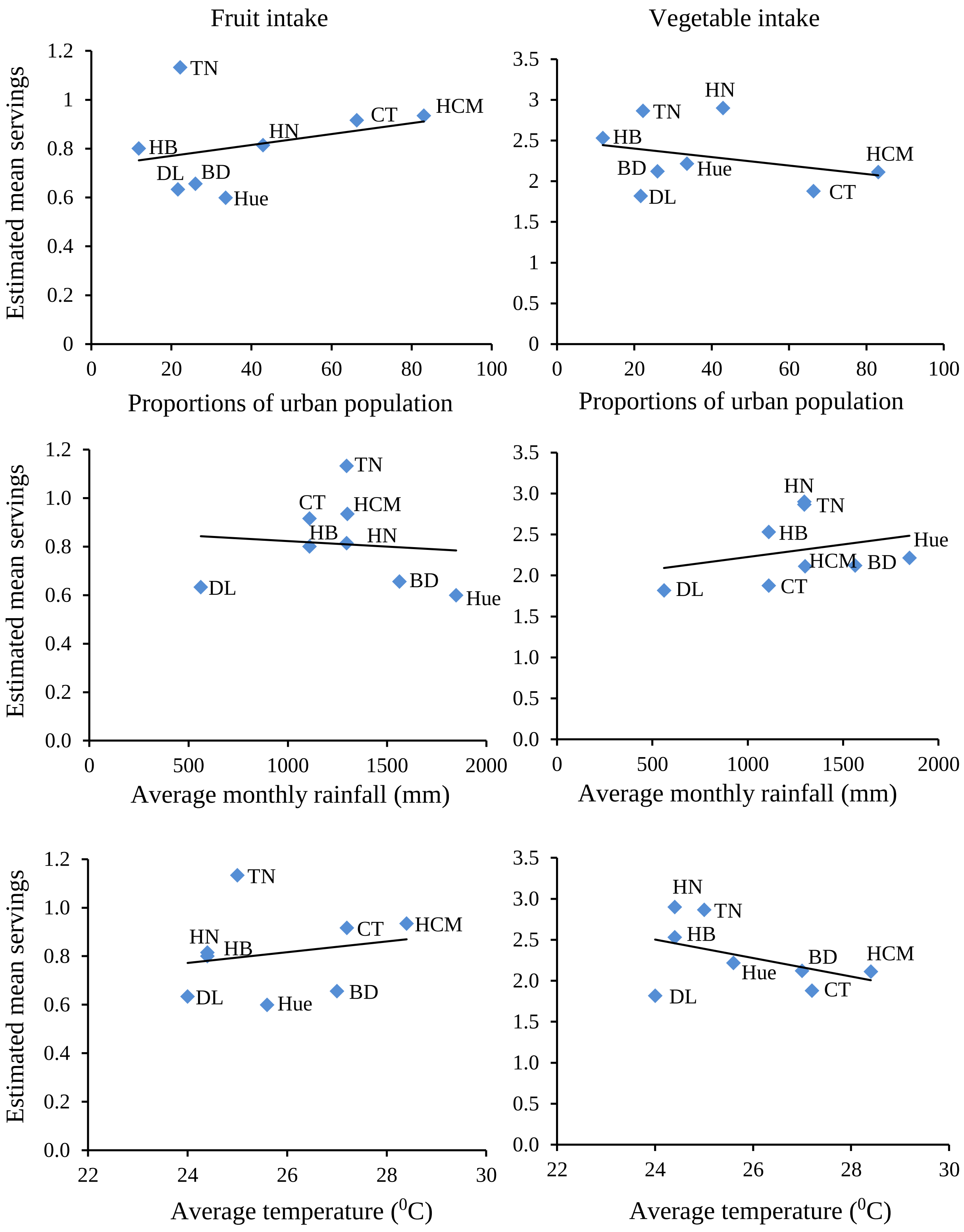
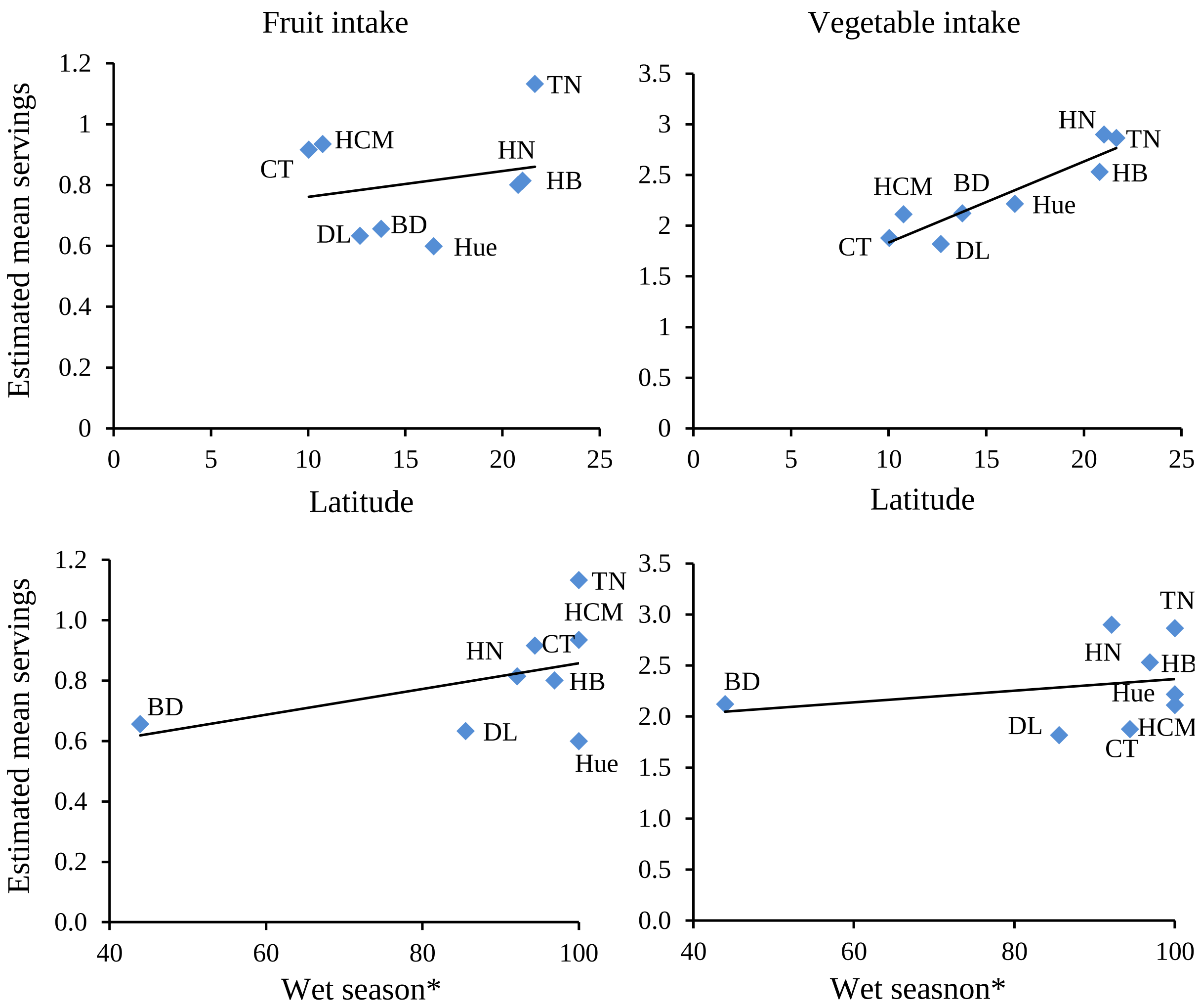
Appendix 6.A. Additional Figures



Additional Figure 6.A.1. Estimated proportions of the Vietnamese population consuming fruit and vegetable in three northern-most provinces (top) and two southern-most provinces (bottom)


Fruit intake
Vegetable intake
Estimated mean servings
Proportions of urban population
Average monthly rainfall (mm)
Average temperature (⁰C)
TN
HN
CT
HCM
HB
DL
BD
Hue



Additional Figure 6.A.2. Correlations between provincial mean servings of fruit and vegetables and demographic, geographical and climatic factors of each province

(Abbreviation: TN – Thai Nguyen, HB – Hoa Binh, HN – Ha Noi, Hue – Thua Thien Hue, BD – Binh Dinh, DL – Dak Lak, HCM – Ho Chi Minh City and CT – Can Tho) among men.

*Proportions of respondents who were interviewed in the wet season of each province

Appendix 6.B. Additional Tables

Additional Table 6.B.1.Mean servings of fruit, vegetables, and fruit and vegetables combined, and proportions of respondents consuming at least five servings of fruit and vegetables per day

	Northern provinces*	Southern provinces†
	%, Mean(n/N, SD)	%, Mean(n/N, SD)
Men		
Fruit‡	0.9(1.0)	0.9(1.0)
Vegetables‡	2.9(1.7)	2.0(1.5)
Fruit and vegetable‡	3.8(2.1)	2.9(2.1)
≥ 5 servings§	25.2%(609/2557)	17.0%(261/1554)
Women		
Fruit‡	1.0(1.0)	1.0(1.0)
Vegetables‡	2.8(1.5)	2.0(1.3)
Fruit and vegetable‡	3.8(2.0)	3.0(2.0)
≥ 5 servings§	24.6%(816/2983)	17.1%(325/1868)

* Thai Nguyen, Hoa Binh and Ha Noi.
† Ho Chi Minh and Can Tho.
‡ Mean (SD) servings of fruit, vegetables, and fruit and vegetables combined.
§ Proportion of respondents consuming greater than five servings of fruit and vegetables per day.

Additional Table 6.B.2. Estimated means of fruit/vegetable consumption without and with adjustment for seasonal variation in five provinces where measurement occurred in both wet and dry seasons, and overall (total for all eight provinces)

	Thai Nguyen		Hoa Binh		Ha Noi		Hue		Binh Dinh		Dak Lak		HCM		Can Tho		Total	
		Adjusted		Adjusted		Adjusted		Adjusted		Adjusted		Adjusted		Adjusted		Adjusted		Adjusted
Men																		
Fruit	0.6	–	0.6	0.6	0.6	0.6	0.4	–	0.4	0.3	0.4	0.4	0.6	–	0.6	0.6	0.5	0.5
Vegetable	2.5	–	2.0	2.0	2.0	2.0	2.0	–	2.0	2.0	2.0	2.0	2.0	–	1.9	1.8	2.0	2.0
Fruit and vegetable	3.4	–	2.7	2.7	3.5	3.4	2.4	–	2.4	2.3	2.3	2.2	2.9	–	2.6	2.4	2.7	2.7
≥ 5 servings (%)	27.9	–	14.3	14.5	25.8	25.8	13.4	–	11.6	10.1	5.2	5.2	20.0	–	15.3	14.4	18.3	18.1
Women																		
Fruit	0.6	–	0.6	0.6	0.9	0.9	0.4	–	0.4	0.4	0.6	0.6	1.0	–	0.8	0.9	0.6	0.6
Vegetable	2.0	–	2.0	2.0	2.0	2.0	2.0	–	2.0	2.0	1.7	1.7	2.0	–	1.7	1.7	2.0	2.0
Fruit and vegetable	2.9	–	3.3	3.3	3.3	3.3	2.6	–	2.3	2.3	2.1	2.3	3.0	–	2.4	2.4	2.7	2.7
≥ 5 servings (%)	21.1	–	24.5	24.7	28.8	28.9	16.7	–	7.9	5.8	7.9	8.0	24.9	–	11.9	12.4	18.2	18.1

Chapter 7. Summary, implications, and directions for future research

7.1 Preface

This chapter summarises the findings of the research presented in this thesis, discusses the implications of the findings, outlines the strengths and limitations of the work, and identifies directions for future research.

7.2 Background and the aims of thesis

Non-communicable diseases are the leading causes of death worldwide (1). Recent data from the INTERHEART (2) and INTERSTROKE studies (3) have demonstrated that tobacco smoking, excessive alcohol consumption, physical inactivity, inadequate consumption of fruit and vegetables, psychosocial factors, obesity, hypertension, diabetes, and abnormal lipids account for 90% of the risk of acute myocardial infarction and stroke worldwide. Importantly, in Southeast Asia and Japan, around 70% of acute myocardial infarction can be attributed to just four behavioural risk factors. They are tobacco smoking, irregular alcohol use, physical inactivity, and poor diet (2). These four behavioural risk factors are amenable to interventions to reduce their levels or prevalence. To reduce or at least limit the growth in non-communicable disease (NCD) morbidity and mortality, priority arguably should be given to implementing programs to do so. To assist health policy-makers to better target, evaluate and fine-tune these interventions, it is critical to have ongoing surveillance of these risk factors. Whilst pathophysiological factors such as body composition, blood pressure, and blood chemistry indices can be measured using standard diagnostic tests established in developed countries, behavioural risk factors are more culturally specific and can only be accurately measured by instruments that have been locally adapted and tested.

In Vietnam, information collated from hospital records indicates that there was a 30% increase in NCD morbidity and mortality rates between 1976 and 2009 (4). Prior to the studies presented in this thesis, there was no nationally-representative information on risk factors for NCDs. Using data from a national survey of NCD risk factors, the principal aim of this thesis was to provide national estimates of the mean levels or prevalence of NCD risk factors in Vietnam. The secondary aim was to investigate issues in the measurement, analysis, interpretation and reporting of NCD risk factors using the "WHO STEPwise approach to surveillance of risk factors for non-communicable disease" (STEPS) methodology (5).

7.3 Material and methods

A population-based survey was conducted during 2009−10 using the WHO STEPS methodology (5). Participants aged 25−64 years were selected from eight provinces (Thai Nguyen, Hoa Binh, Ha Noi, Hue, Binh Dinh, Dak Lak, Ho Chi Minh and Can Tho) each representing one of the eight ecological and geographical regions of Vietnam. Of the 22,940 eligible subjects selected by stratified multi-stage cluster sampling, 14,706 (64.1%) participated in this survey. National estimates of eight NCD risk factors are presented in the first of five studies reported in this thesis, and the other four studies provide more detailed information on tobacco smoking, alcohol use, physical activity (PA), and fruit and vegetable intake. All analyses were performed using complex survey methods provided by Stata version 12.0.

7.4 Major findings

The main findings of each study are summarised below.

Chapter 2 provides national estimates of eight NCD risk factors. Notable findings were sex-differences in proportions of current smokers (men 57.7%, women 1.7%), binge drinkers (men 25.1%, women 0.6%), active people (men 52.0%, women 41.1%), and hypertension (men 18.5%, women 10.2%). Smaller differences were found in the means of fruit/vegetable intake (men 2.7, women 2.8), BMI (men 21.1, women 21.2) and blood cholesterol (men 5.6, women 5.7), and in the proportion of persons with diabetes (men 2.6%, women 2.5%). The correlations between the summary values for each province were generally plausible (e.g. proportion of urban population and mean BMI, r=0.82), but with some anomalous findings due to the characterisation of smoking and hypertension by STEPS protocols.

More detailed information on tobacco use is presented in Chapter 3. Male ever-smokers commenced smoking at a median age of 19.0 [interquartile range (IQR) 17.0, 21.0] years and smoked median quantities of 10.0 (IQR 7.0, 20.0) cigarettes/day. Female ever-smokers commenced smoking at a median age of 20.0 (IQR 18.0, 26.0) years and smoked median quantities of 6.0 (IQR 4.0, 10.0) cigarettes/day. For men, the proportion of current daily smokers peaked in the 1965−69 birth cohort and has declined in more recent cohorts ($p=0.001$). For women, the proportion of current daily smokers has declined in successive cohorts after the 1950−54 cohort ($p<0.001$).

Chapter 4 provides more detailed information on alcohol use. Almost 60% of men but only 4% of women consumed alcohol during the last week. Nearly 40% of men were hazardous/harmful users. Gains in model calibration and subject discrimination from the regression of blood pressure or hypertension on variables representing information on quantities consumed measured by 'standard drinks' were minor relative to the contribution from binary responses to questions on whether or not alcohol had been consumed during the reference period.

Chapter 5 provides more detailed information on PA, including domain-specific and overall PA. Approximately 20% of the Vietnamese population had no measureable PA during a typical week, but 72.9% of men and 69.1% of women met WHO recommendations for PA by adults for their age. The vast majority of recorded PA was from work activity, which was higher in rural areas and varied by season. Less than 2% of respondents provided incomplete information, but an additional one-in-six provided unrealistically high values of PA. Box-Cox transformation was the most successful method of reducing the influence of large values, but the strongest correlations were produced when high values of PA were scaled down to values consistent with average energy intake of the Vietnamese people.

More detailed information on fruit and vegetable consumption is presented in Chapter 6. Nearly 80% of Vietnamese people have less than five servings of fruit and vegetables daily in a typical week. Fruit and vegetable intake reported in 'standard serving' sizes was positively correlated with levels of education and household income ($p<0.001$ for trend). The correlations between summary values for each province were plausible because they reflect some known demographic, geographical and climatic characteristics of the country. For example, provinces located at lower latitudes where rice constitutes a larger component of the diet had lower mean servings of vegetables ($r=0.90$), and provinces with higher proportions of urban population had higher mean servings of fruit ($r=0.40$). The STEPS questionnaire does not provide quantitative measures of energy intake, and investigating the associations of fruit and vegetable intake with pathophysiological factors is contraindicated in the absence of caloric intake data.

7.5 Implications of the research

The research presented in this thesis makes a significant contribution to the development of an evidence base for public health policy-making in response to increasing NCD morbidity and mortality in Vietnam. National estimates of the mean levels or prevalence of eight risk factors for NCD are provided. An additional contribution is made by increasing understanding, in the context of a developing country, of measurements made using the STEPS methodology and how those measurements should be analysed, interpreted and reported. The implications of these findings are discussed in the following sub-sections.

7.5.1 Implications of findings on the mean levels or prevalence of NCD risk factors

The findings presented in Chapter 2 of this thesis show that mean levels of BMI and blood cholesterol, and proportions of persons with hypertension and diabetes, were consistent with values reported for Southeast Asian nations, but lower than those for Western nations (1, 6). The summary information presented on socio-demographic, behavioural and pathophysiological factors reflects the changing NCD risk factor profile of a country undergoing industrialization/urbanisation. For example, the findings that greater schooling and income were associated with reduced PA but higher BMI are consistent with previous reports (7-10). Urbanisation was associated with a higher prevalence of overweight/obesity, hypertension and diabetes, and these findings are consistent with those for other populations (11, 12). Increased adiposity and hypertension are a predicted consequence (8, 13) of the urbanisation that Vietnam has experienced in the recent past (14). Although re-constructed birth cohort analyses of body size/fatness were not possible with the cross-sectional data collected on body size, mean waist circumference not explained by age and mean WHR not explained by age have increased in recent birth cohorts of both men and women (analyses not reported). These findings strengthen the case for interventions to promote healthy eating and PA in order to prevent future increases in overweight/obesity and its probable consequences of hypertension, elevated glucose and hypercholesterolemia even though the mean levels or prevalence of these risk factors are not at alarming levels at present. Our findings in respect of the sex, urban-rural and regional differences in the mean levels or prevalence of pathophysiological risk factors provide valuable information that could help public health authorities in planning and evaluating NCD intervention strategies. For instance, the sex-difference in proportions with raised blood pressure highlights the need for sex-specific interventions to address risk factors. Reducing prevalence of tobacco smoking by men, an established risk factor for hypertension, should be a priority. Besides the implementation of interventions exclusively targeting specific behavioural risk factors, there is a need to implement multiple-faceted interventions because previous findings have shown that behavioural risk factors often cluster among individuals, and success in changing one risk behaviour might increase motivation and self-confidence, or serve as a "gate way", to change other risky behaviours (15-17).

The findings presented in Chapter 3 of this thesis suggest that the decline in smoking prevalence in more recent birth cohorts of adult men coincided with the introduction of tobacco control initiatives commencing in the 1990s. Our findings are consistent with the evidence (18) that key tobacco control interventions (19) including excise tax increases, mass media campaigns, and public and work place smoking bans are cost-effective in Vietnam. However, the prevalence of tobacco smoking among men remains high, and a low quit rate is likely to predispose most of those who start smoking to premature mortality and morbidity. The cost-effective interventions cited, together with other approaches such as point-of-sale restrictions and graphic warning labels on cigarette packs (18), should be maintained and implemented more widely. In addition to those interventions, the importance of strengthening strategies to encourage current smokers in Vietnam to quit smoking, and to assist them to do so by offering cessation advice integrated in primary health-care activities, counselling services, and low-cost pharmacological therapy, needs to be emphasized (20).

Our findings on smoking prevalence among women suggest that product promotion strategies used by tobacco companies (examples include mass media, sponsorships, point-of-sale advertising and product placement in films when allowed) have not succeeded to date with Vietnamese women. The findings are consistent with evidence that smoking by women is considered by Vietnamese people to be inappropriate and associated with "loose morals" (21). Social mores on smoking may play an important role in dissuading women from initiating smoking, and this appears to be the case in Vietnam. But it may not last. In Western countries prior to the 1950s, smoking by women was widely disparaged as lacking refinement but that attitude was gradually worn down by a series of product changes implemented from the 1950s onwards – the introduction of manufactured cigarettes, the addiction of cork tips (to preserve a woman's lipstick) and then filter-tips – together with aggressive marketing of menthol cigarettes to women as providing freshened breath and oral hygiene (22, 23). Increased prevalence of smoking by Vietnamese women is predicted by the smoking diffusion model based on Western experience (24-28), and anticipated as a consequence of increased marketing efforts by tobacco companies in developing countries (29). If so, whilst there is no need for it at present, public health interventions designed to prevent smoking uptake by Vietnamese women may need to be strengthened in the future.

Although alcohol use and harmful consumption is less pronounced in Vietnam than in Western countries (30), these behaviours are much more common among Vietnamese men than women. This may reflect the cultural practice in Vietnam and in other Asian countries (31). Because there are strong links between hazardous/harmful and binge drinking and chronic disease outcomes such as hypertension (32, 33), CVD (2, 34) and stroke (3), culturally appropriate public health strategies to reduce hazardous/harmful drinking behaviour are needed, particularly for men. Increasing alcohol beverage excise taxes, restricting access to retailed alcohol beverages, and comprehensive advertising, promotion and sponsorship bans have been shown to be cost-effective in Vietnam (35), and they need to be maintained with the objective of reducing or limiting growth in prevalence of this risky behaviour.

The results presented in Chapter 5 of this thesis confirm that the proportion of Vietnamese people not meeting WHO physical activity recommendations is generally lower than those reported in Western countries (1). Nevertheless, our data show that work activity comprises a major portion of total PA and, unless PA in other domains (transport and leisure) can be increased by cost-effective interventions, overall PA will decline if work activity diminishes in response to further industrialization/urbanisation. Reduced work and total PA has already occurred in China (36) where, similar to Vietnam, work and total PA are significantly lower in more urbanised provinces and in the urban areas of rural provinces. Whilst birth cohort analyses of PA could not be conducted with these cross-sectional data, mean total PA not explained by age has declined in the most recent birth cohorts (the 1975–79 and 1980–84 birth cohorts) of both men and women (analyses not reported). At present, more than three quarters of Vietnamese people do not undertake any measurable leisure-time activity, and spend no time on walking or biking to get to and from places. Mass media campaigns to motivate and support individuals and communities to be more active will need to be implemented if increased leisure and transport activity are to compensate for future declines in work activity. Encouraging people to walk or cycle to and from places, and to spend more time in leisure activity, by mass media campaigns is among the most cost-effective of interventions to promote PA (37).

The proportion of Vietnamese people meeting the WHO recommendation for fruit and vegetable intake is generally similar to, or even higher than, the findings in other developing (38) and Western (39, 40) countries. Whilst more than 90% of Vietnamese people consume at least one serving of fruit or vegetables per day, only one-in-five consume at least five servings of fruit and vegetables as recommended by WHO. A recent meta-analysis of data from 16 prospective cohort studies mostly conducted in Western countries have shown that higher consumption of fruit and vegetables is associated with a reduced risk of all-cause mortality, with an average reduction in risk of 5–6% for each additional serving of fruit or vegetables (41). Even if further industrialization is accompanied by increased consumption of fruit and vegetables, which is a plausible implication of the positive associations found in this thesis between fruit and vegetable intake and education or income, those benefits could be enhanced by effective interventions to further increase consumption. The results of a survey conducted in Austria show that the greatest barrier to increasing the number of servings is the perception that the current consumption of an individual was already sufficient (42). The findings suggest that strategies to increase intake of fruit and vegetables should pay more attention to those barriers, and to recognition that each additional serving consumed has beneficial effects on health. A further strategy worth considering is that being used in developed countries such as Australia to increase fruit and vegetable consumption in rural areas not serviced by supermarkets and specialist green grocers. That strategy is to encourage community gardens to develop and to support them to grow.

7.5.2 Implications of findings on measurement issues

Our findings on socio-demographic factors are consistent with data from the national census (43, 44) and the associations between summary measures of the NCD risk factors appear sociologically and biologically plausible. These findings suggest that the national estimates had some evidence of construct and associative validity, and that the STEPS methodology (5) is generally acceptable for use in Vietnam but with caution needed in the interpretation of the associations of summary estimates due to characterization of tobacco smoking and hypertension as per STEPS protocols. For tobacco use among Vietnamese men, current smoking was negatively associated with raised blood pressure and glucose because those at highest risk were ex-smokers. Our group identified the hypertension phenomenon previously in a survey in Can Tho (45), and proposed that this was likely due to smokers being prompted to quit by a diagnosis of hypertension. The STEPS core instrument refers exclusively to current smokers and the STEPS report template requires reporting only of the proportion of current daily smokers and their years of smoking and quantities smoked, however. These findings should encourage those using the STEPS instrument to collect, and report, information on ex-smokers to more accurately represent the behavioural profile of their populations. For hypertension, our findings demonstrate that raised blood pressure defined as SBP ≥140 mmHg and/or DBP ≥90 mmHg may lead to implausible provincial-level correlations with summary measures of other risk factors including PA, mean BMI and cholesterol. This definition does not account for blood pressure treated by antihypertensive medication or other means. The prevalence of uncontrolled raised blood pressure is an important health system indicator, and the findings show that the uncontrolled high blood pressure definition of hypertension results in unlikely associations with other risk factors. This problem was resolved by including those using medication for, or previously diagnosed with, hypertension in the definition of raised blood pressure. These results suggest that those using STEPS protocols need to consider the definition of raised blood pressure that is appropriate for their population, and to be aware that the use of the recommended definition may cause spurious associations. Furthermore, although the validity of the summary estimates for inter-country comparisons was tested through the prism of inter-province comparisons within one country, and to the extent that the results can be generalised in this way, the findings hint that the STEPS methodology is appropriate for the intended purpose of cross-cultural comparisons.

Our estimates of quantities of alcohol consumed expressed in terms of standard drinks had some evidence of construct validity in terms of associations with education and tobacco smoking that were consistent with previous findings of studies in Asian populations (46, 47). The findings accord with the evidence that there is a strong link between the number of standard drinks consumed and the mean levels of BP and the prevalence of hypertension in both Asian (48-51) and Western populations (50, 52-54). The evidence of construct validity was indirect and limited, however. It was based on the observation that prediction of those outcomes by variables representing information on quantities measured by standard drinks was not worse than prediction by variables representing information on frequency of consumption. Most of the improvement in model calibration and subject discrimination in mathematical models of the relationship between blood pressure/hypertension and alcohol consumption was provided by binary responses to questions on whether or not alcohol had been consumed during a specific period. Because the purpose of the STEPS methodology is to obtain small amounts of useful information on a regular and continuous basis when resources are limited, our findings suggest that asking further information on the quantities consumed in terms of standard drinks imposed an additional burden on subjects that is not justified.

That one-in-six respondents reported unrealistically high values of PA in response to GPAQ, and an additional 2% provided incorrect information, shows that nearly 20% of Vietnamese respondents had difficulty coping with the questionnaire. Those who made such reporting errors were men and particularly the less well-educated among them, younger persons, those who reported a second type of work activity and residents of rural areas who did not, those of non-Kinh ethnicity, and persons from low-income households. Over-estimation of self-reported PA in response to the GPAQ questionnaire when administered in the Vietnamese population has been identified previously (55). Two possible sources of this are the Western concepts of intensity and continuity of effort, and the reference period characterised as a typical week. Pointing to the first of these explanations is the finding that around 10% of respondents reported levels of vigorous activity that improbably required energy expenditure every day of a typical week of the past year in excess of the average energy intake (2100 kcals) of Vietnamese people (56, 57). Either these respondents misunderstood what is required in moderate and vigorous activity, or they were unduly influenced in their reporting by recent bouts of high activity. The second explanation is in accordance with a previous finding by our group (58) that the stability of work patterns influences the reporting of PA by GPAQ, with greater evidence of accuracy in reporting for those with stable work patterns. Further evidence from this thesis was the seasonal variation in reporting of PA that has been reported previously (10, 59), and that suggests respondents in developing countries are unduly influenced in reporting by their most recent activity. In this population, reporting of fruit and vegetable intake also varied by season. The GPAQ was designed as an improvement on IPAQ, but the results of a recent assessment (60) have shown that, similar to IPAQ, the

GPAQ has only poor to fair criterion validity and moderate reliability. It nonetheless has been claimed to be a suitable and acceptable instrument for monitoring the PA of populations (60). The findings on the issues that arise in the administration of this questionnaire in low- and middle-income countries, such as Vietnam, provide possible explanations for its unfavourable psychometric properties. Partly due to exaggerated PA values in this study, there are reporting issues that arise irrespective of country of application because the PA data are zero-inflated and right-skewed. The GPAQ Analysis Guide (61) provides limited guidance in these respects, however. Of the several methods for handling the zero-inflated and right-skewed data, the Box-Cox transformations produced the most plausible summary values. For data with zero values, this method requires a constant to be added to each observation, and it was possible to choose a value of the constant that produced a design-based mean most like the corresponding median in each stratum and sub-domain. Searching for this value was straightforward and feasible to do.

Information on quantities of fruit and vegetables consumed in terms of standard serving sizes had some evidence of construct validity because the measurements were plausibly correlated with socioeconomic factors in individual-level analyses, and with provincial characteristics in aggregate analyses. However, fruit and vegetable intake was positively associated with body size/fatness, and these associations were independent of age, income, education, tobacco smoking, alcohol consumption, and physical activity. If those who ate more fruit and vegetables were also eating more of other high-energy foods, and total energy intake is a contributor to larger body size/fatness, adjusting for other energy sources would attenuate the positive associations, and could unmask a protective association of fruit/vegetable consumption with body size/fatness if the cross-correlations with energy intake are of sufficient magnitude (62). Our findings thus suggest that the data collected using the STEPS instrument are not useful for the investigation of the association between fruit and vegetable intake and pathophysiological factors (e.g. BMI, blood glucose and cholesterol) because information on total energy intake is not available.

The four simple questions included in the STEPS questionnaire seeks reporting of fruit and vegetable consumption in a typical week, but the reported fruit and vegetable intake varied by season. Because actual fruit and vegetable consumption patterns display seasonal variability (63), this would be unsurprising were it not for the fact that the STEPS questionnaire asks about comsumption in a typical week. It suggests that Vietnamese people are influenced in reporting by their intake in the most recent season and, together with seasonal reporting of PA, suggests that a substantial number of respondents found the concept of a typical week difficult to comprehend and deal with. To illustrate the impact of this issue, our data suggest that a survey conducted in the wet season could produce mean estimates of fruit and vegetable intake that are 10% higher than those of a survey conducted in the dry season. Although the seasonal variation in reporting intake in this survey had only minor impact on the national estimates because a large majority of the interviews were conducted in the wet season, this is an important issue to be considered when planning surveys.

7.5.3. Implications of the findings for NCD intervention policy

Although mean levels of BMI and blood cholesterol, and proportions of persons with hypertension and diabetes, were lower than those for Western nations (2, 7), future worsening of NCD risk factors in Vietnam can be expected in consequence of an aging population, rapid urbanization, increasingly sedentary lifestyles and more energy-dense diets (5, 8).The studies reported in this thesis have identified the high prevalence of smoking by Vietnamese men, inadequate fruit and vegetable intake, and physical inactivity in high-income urban areas as factors of major concern.

Although the proportion of current daily smokers has declined in recent cohorts, relatively few Vietnamese men quit smoking. Consequently, the proportions of deaths due to tobacco smoking is expected to increase in the coming decades as in other developing countries (9). Tobacco-related diseases and mortality impose a significant burden on the economy of the country. Reducing current smoking prevalence needs to be considered as the first priority in preventing NCD because of its beneficial impact. Current implementations of cost-effective interventions (2) including bans on tobacco advertising and promotion in addition to sponsorship, warning about the dangers of tobacco use, and restricting access to retailed smoking need to be enforced by legislation. Higher taxes and cigarette prices would achieve greater reductions in tobacco use because cigarette consumption is highly price-elastic. For example, tripling excise tax on tobacco would enable a doubling of the inflation-adjusted price of cigarettes, and reduce tobacco consumption by a third (10). Revenue from tax on tobacco could be used to finance health systems, especially for the benefit of vulnerable groups, further increasing health and societal gains. Interventions including graphic warning labels on cigarette packs or plain paper packing should be implemented (10). Implementing strategies to encourage Vietnamese smokers to quit smoking, and to assist them to do so by offering cessation advice integrated in primary health-care activities, counselling services, and low-cost pharmacological therapy has been found to be cost-effective (11).

Increasing fruit and vegetable intake and PA in urban areas is also important for NCD intervention. Promoting public awareness of healthy diets through mass media is a cost-effective intervention (2). Encouraging people to walk or cycle to and from places, and to spend more time in leisure activity, by mass media campaigns is among the most cost-effective of interventions to promote PA (2).

Even if they are not major concerns at present, the impacts of other behavioural and pathophysiological risk factors are expected to worsen in future years in developing countries such as Vietnam (5, 8). Cost-effective interventions and their evaluations should be implemented to reduce the impact. Surveillance and monitoring of modifiable behavioural, pathophysiological risk factors and cause-specific mortality is essential for the evaluation of these interventions.

7.6 Strengths and limitations of this research

This research has several strengths. First, the participants were a nationally-representative population-based sample selected by multi-stage stratified sampling with probabilities proportional to cluster size at the penultimate stage and with equal probabilities at the final stage. The large sample size and an extensive range of study factors allowed stratification by sex and rural/urban location, and for account to be taken of putative modifying, confounding and mediating factors. Second, the interviews and measurements were conducted by trained staff in accordance with standardised WHO protocols designed to minimise avoidable sources of random error and bias, and using a culturally-sensitive instrument that had been translated and back-translated. Third, because behavioural risk factors are more culturally specific and the instruments used to measure them need to be locally adapted and tested, an assessment of the measurements of the behavioural risk factors is presented in this thesis.

However, there are a number of limitations that need to be considered when interpreting the findings of this research. First, whilst the response proportion was high for a study requiring lengthy clinic attendance with overnight fasting and blood-sampling, the possibility of non-participation bias cannot be discounted. Second, information on smoking, alcohol consumption, physical activity and fruit and vegetable intake was self-reported, and subject therefore to random and possibly systematic errors of recall. This method of collecting data on these risk factors is standard practice, however, and information collected in this way has been shown to have some evidence of validity (55, 58, 71-73). Using accelerometers or pedometers may have reduced measurement error in estimation of physical activity if movement and ambulatory activity are an accurate measure of total activity, but the cost of these devices and of their recovery after use reduces their feasibility in large-scale field work in many low resource countries including Vietnam. Third, residual confounding may be another potential limitation of this research. For example, unmeasured factors may be responsible for the differences in hypertension between urban and rural areas, with salt intake (higher in rural areas) a possible candidate. Adjusting for self-reported information on saltiness of diet did not remove those differences in this study, but the accuracy of the self-reported information on salt in diet was uncertain. Fourth, there was some evidence of systematic error (e.g. inflated values, seasonal influences) in the estimates of risk factors. Seasonal variation in reporting PA or fruit and vegetable intake is clearly an issue to be concerned about when planning and conducting surveys using the STEPS methodology. The national estimates of risk factors presented in this research were from data mostly collected in one specific season – the wet season – and the impacts of seasonal reporting were negligible on the national estimates. The influence of PA inflated values was minimised by Box-Cox transformation of the data with an appropriate constant added. Nevertheless, that this was due to systematic error that should prompt a re-evaluation of the STEPS questionnaire instrument.

7.7 Directions for future research

The findings reported in this thesis have broadened the knowledge of the mean levels or prevalence of NCD risk factors in Vietnam at regional and national levels, and have contributed to improved understanding of the NCD risk profiles of the Vietnamese population. In addition, it has provided evidence of the general acceptability of the STEPS methodology for use in Vietnam but with important limitations identified. Furthermore, it has brought to light several gaps that need to be filled by future research. Those gaps are outlined in the following paragraphs.

First, the associations between summary estimates of NCD risk factors collected by the WHO STEP instrument and other correlations with socio-demographic, geographic and pathophysiological factors were generally plausible. Verification of this was important because it was likely that users of the data would undertake those associative analyses themselves when making provincial comparisons even it informally. However, these ecological comparisons were based on data from different regions within a single country and, to confirm its utility more generally for cross-cultural comparisons, further investigation regarding the validity of contrasts between countries is recommended.

Second, there appeared to be a decline in smoking prevalence in recent cohorts of men and successive cohorts of women. This work was based on the re-constructed birth cohort analysis method (25) using data collected at a single point in time. This decline should be confirmed with longitudinal data or by repetition of one of the cross-sectional surveys that have taken place including STEPS survey. Further research exploring factors associated with not taking up smoking (particularly by women) or quitting smoking is also needed.

Third, consumption of alcohol reported in standard drinks had some evidence of predictive validity with blood pressure and hypertension. However, the questions on alcohol consumption used in the WHO STEPS questionnaire are an adaption of the quantity/frequency approach (74). Further assessment the comparative validity of questions based on the graduated frequency approach (74) is desirable. One of the principal guidelines of the WHO's global strategy in reducing the harmful use of alcohol is to consider the national, religious, and cultural context in recommending actions (75). Therefore, more qualitative research exploring the sex-differences and cultural practices in alcohol use is also needed to reduce the risk of harmful/hazardous and binging drinking.

Fourth, accurate measurements of sodium intake are needed to facilitate these analyses, and to inform national/international public health initiatives to reduce sodium consumption. There is strong and consistent evidence from animal studies, epidemiological data and clinical trials both within and across populations implicating high salt intake as an important risk factor for high blood pressure among both hypertensive and normotensive individuals (76-80), and high salt intake is associated with increased risk of future CVD and stroke (81, 82). Salt intake may be responsible for the differences in blood pressure between urban and rural areas, and for confounded associations between blood pressure and other behavioural risk factors in our findings. Only self-reported information on the saltiness of diet was considered in the research reported in this thesis, however. In order to quantify the total amount of sodium consumed by individuals per day, collection of urine over a 24-hour period is recommended. However, asking participants to collect their urine over a 24-hour period would be significantly burdensome and is likely to deter participants from being involved in other steps of the survey. Although 24-hour urine collection is generally considered the 'gold standard' for estimation of population sodium intake, spot urine collection is increasingly used as a convenient and affordable alternative in low resource settings (83, 84).

Fifth, because reporting of PA varies between those who have stable and unstable work patterns (58) and by season, and because responses to questions on fruit and vegetable consumption differ also by season, the concept of a 'typical week' used in the STEPS questionnaire appears not well-suited for use in this population. Further research is required on what reference period is best for reporting these behavioural risk factors.

Sixth, because only 1-in-5 Vietnamese people reported having at least five servings of fruit and vegetables daily, further studies on the barriers to increasing the number of servings of fruit and vegetables are recommended. In addition, the current recommendation of five servings of fruit and vegetables per day requires further attention. The results of a recent meta-analysis have shown that fruit and vegetable intake may have a dose-response relation with all-cause mortality (41), but these studies were mostly conducted in Western countries. The beneficial effects of fruit and vegetables may differ between Asian and Western populations, and further research on what cut-point is best for each population is desirable.

Finally, to assess the validity of these brief questions on fruit and vegetable intake, additional data on total energy intake is required in validation studies because the STEPS questionnaire does not provide information on total energy intake. These further assessments need also to take into account the seasonal variation in the availability of food, and the different dietary patterns of the regional and socio-demographic groups of the country.

7.8 Conclusions

This thesis provides the first nationally-representative estimates of mean levels or prevalence of NCD risk factors in Vietnam. These data suggest that efforts to limit future growth in

NCDs should be targeted at reducing tobacco smoking and binge drinking by men, encouraging physical activity, and increasing consumption of fruit and vegetables. These interventions should take account of the sex-, urban-rural and regional differences in these risk factors that were identified in this thesis. The results from this research could help to strengthen the implementation Programme of Prevention and Control of Certain Non-communicable Diseases for the Period 2010–2020 in Vietnam. In addition, the findings from the extensive assessment of the application of the STEPS instrument in Vietnam in respect of the measurement of behavioural risk factors, and the analysis, interpretation and reporting of the results, should be of value for other investigators using the instrument and for other users of data.

7.9 References

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Appendix 7.A

STEPS instrument for the Vietnam NCD Risk Factor Survey 2009-2010 (back translated version)

Following is the English translation of the STEPS instrument used to conduct the Vietnam NCD Risk Factor Survey 2009–2010

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

WHO STEPS INSTRUMENT
FOR CHRONIC DISEASE RISK FACTOR SURVEILLANCE
VIET NAM 2009–2010

General information			
I6	Consent has been read and obtained	Yes 1 No 2 *If no, read the consent*	
I7	Participant agree to participate *(verbal or written)*	Yes 1 No 2 *If No, END*	
I8	Interview language	English 1 Vietnamese 2 Other (Specify ....) 3	
I9	Time of interview (24 hour clock)	— — : — — Hour minute	
I10	Participant's full name	....	
XI10	Participant's common name	....	
XI11	Address - *For urban area: specify street number, street name, ward* - *For rural area: specify village/hamlet*	Street number... Street/village/hamlet... Commune.. District.. Province……..	
I12	Contact phone number *(if any)*	....	
XI13	Whose phone *(work/home/neighbour's)*	....	
Contact person when required			
XI14a	Full name	....	
XI14b	Common name	....	
XI14c	Relationship with participant	....	

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

XI14d	Address (If not living in the same house) - *For urban area: specify street number, street name, ward* - *For rural area: specify village/hamlet*	....		
XI14e	Phone number (if any)	....		
XI15	Do you agree to continue to participate in this study in the future?		Yes 1 No 2	
Location and time of clinic				**Code**
XI0a	Province......................................	XI0b	Code of province	
XI1	District	I1	Code of district	00
I2	Commune	I3	Code of commune	
I5	Date of interview: dd..../mm...../yyyy.........	I4	Interviewer ID	

Step 1 Demographic information

Question		Answer		Code
C1	Sex (as observe)	Male Female	1 2	
C2	What is your date of birth (western calendar)? *If not known, write 77/77/7777*	____/ ____/ ______ Day month year *If known, go to C4*		
C3	How old are you? *(interviewer use the horoscope converter if necessary)*	Year		__ __
C4	In total, how many years have you spent at school or in full-time study (excluding pre-school)?	Year		__ __
C5	What is the highest level of education you have completed?	No formal schooling Less than primary school Primary school completed Secondary school completed High school completed College/University completed Post graduate degree	1 2 3 4 5 6 7	

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

C6	What is your ethnic group?	Kinh	1	
		Other (specify) …............................	2	
C7	Which of the following best describe your <u>main</u> work status in the last 12 months?	Government employee	1	
		Non-government employee	2	
		Self-employed	3	
		Non-paid	4	
		Student	5	
		Homemaker	6	
		Retired	7	
		Unemployed (able to work)	8	
		Unemployed (unable to work)	9	
		Other...	10	
XC7a	What is your <u>main</u> work in the last 12 months? *(Interviewer reads the options)*	Farmer	1	
		Industrial worker	2	
		Trader	3	
		Unstably employed	4	
		Homemaker	5	
		Office work	6	
		Other (Specify ....)	7	
		Refuse	8	
XC7b	Do your work activities vary by season?	Yes	1	
		No	2	
XC8	Please tell me the average earning of the household in the **last 12 months** (in VND)	Per week		....
		Per month		....
		Per year		....
XC9	How many people older than 18, including yourself, live in the household?	Number of people		__ __

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT
☐	☐☐	☐☐☐

Step 1 Behavioural measurements

Tobacco use

Now I am going to ask you some questions about various health behaviours. This includes things like smoking, drinking alcohol, eating fruits and vegetables and physical activity. Let's start with tobacco.

Question		Answer	Code
XT0	Have you ever used tobacco in your life?	Yes 1 No 2 *If no, go to T9*	
T1	Do you currently smoke any **tobacco products**, such as cigarettes, cigars or pipes?	Yes 1 No 2 *If no, go toT6*	
T2	**If Yes** Do you currently smoke tobacco **daily**?	Yes 1 No 2 *If no, go to T6*	
T3	How old were you when you **first started** smoking daily?	Age (Year) *If known, go to T5*	__ __
T4	Do you remember how long ago it was? *(RECORD ONLY 1, NOT ALL 3)*	in years	__ __
		OR in months	__ __
		OR in weeks	__ __
T5	On average, **how many** of the following do you smoke each day? *Record for each type*	Manufactured cigarettes	__ __
		Hand-rolled cigarettes	__ __
		Water pipe	__ __
		Pipes full of tobacco	__ __
		Cigars	__ __
		Other (specify... ....) *Go to T9*	__ __
T6	**For those who currently do not smoke daily**: have you ever smoked **daily**?	Yes 1 No 2 *If no, go to T9*	
XT7	**If yes,** how old were you when you **started** smoking **daily?**	Age (Year) *If yes, go to TX9*	__ __

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

XT8	Do you remember how long ago it was?	Years ago	__ __
		OR months ago	__ __
		Or weeks ago	__ __
XT9	When you smoked, on average, **how many** of the following do you smoke each day? *Record for each type*	Manufactured cigarettes	__ __
		Hand-rolled cigarettes	__ __
		Water pipe	__ __
		Pipes full of tobacco	__ __
		Cigars	__ __
		Other (specify... ....)	__ __
T7	How old were you when you **stopped** smoking **daily**?	Age (year) *If known go to T9*	__ __
T8	**How long ago** did you stop smoking daily? (Record 1, not ALL)	Years ago	__ __
		OR months ago	__ __
		Or weeks ago	__ __
T9	Do you **currently use chewing tobacco?**	Yes 1 No 2 *If no, go to XT11*	
T10	If yes, Do you use chewing tobacco **daily**?	Yes 1 No 2	
XT11	Do you currently live/work with a smoker?	Yes 1 No 2 *If no, go to XA0*	
XT12	If yes, how long have you been living/working with that person? *Record 1, not ALL*	Years	__ __
		OR months	__ __
		OR weeks	__ __

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

Alcohol consumption			
The next questions ask about the consumption of alcohol.			
Question		**Answer**	**Code**
XA0	Have you **ever** consumed an alcoholic drink such as beer, wine, spirits, and fermented cider?	Yes 1 No 2 *If no, go to D1*	
A1	Have you consumed an alcoholic drink within the **past 12 months**?	Yes 1 No 2 *If no, go to D1*	
A2	During the past 12 months, **how frequently** have you had at least one alcoholic drink? *(interviewer explain and read the options)*	Daily 1 5-6 days/week 2 1-4 days/week 3 1-3 days/month 4 Less than once/month 5	
A3	When you drank alcohol, **on average**, how many **standard alcoholic drinks** did you have in one day? *(interviewer use SHOWCARD, ask for each type of alcohol and report in standard drinks)*	Number of standard drink	— —
A4	Have you consumed an alcoholic drink within the **past 30 days**?	Yes 1 No 2 *If no, go to A6*	
A5	During each of the **past 7 days**, how many standard alcoholic drinks did you have each day? *(interviewer use SHOWCARD, ask for each type of alcohol and report in standard drinks)*	Monday	__ __
		Tuesday	__ __
		Wednesday	__ __
		Thursday	__ __
		Friday	__ __
		Saturday	__ __
		Sunday	__ __
A6	In the last 12 months, what was the **largest number** of standard alcoholic drinks you had on a single occasion, counting all types of alcoholic drinks together? *(interviewer use SHOWCARD, ask for each type of alcohol and report in standard drinks)*	Largest number *(standard drinks)*	— —

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

Diet			
The next questions ask about the fruits and vegetables that you usually eat. I have a nutrition card here that shows you some examples of local fruits and vegetables. Each picture represents the size of a serving. As you answer these questions please think of a typical week in the last year.			
Question		**Answer**	**Code**
D1	In a typical week, on how many days do you **eat fruit**? *(USE SHOWCARD)*	Number of days *If zero day, go to D3*	— —
D2	How many **servings** of fruit do you eat on **one** of those days? *(interviewer use showcard to calculate and record)*	Number of servings	__ , __
D3	In a typical week, on how many days do you **eat vegetable**? *(USE SHOWCARD)*	Number of days *If zero day, go to XD5*	— —
D4	How many **servings** of vegetable do you eat on **one** of those days? (do not count potatoes) *(interviewer use showcard to calculate and record)*	Number of servings	— , —
XD5	How salty do you eat compare to other members of the family?	Saltier 1 Less salty 2 Similar 3	

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

When you eat **at home**, at the **dinner table**, how often do you add salt into your food (write in relevant box)					
		Frequency	**Breakfast**	**Lunch**	**Dinner**
XS1	Fish sauce, soy sauce, manufactured sauce	Very often 1 Sometimes 2 Rarely 3 Never 4			
XS2	Home-made sauce from salt	Very often 1 Sometimes 2 Rarely 3 Never 4			
XS3	Salt	Very often 1 Sometimes 2 Rarely 3 Never 4			
XS4	MSG	Very often 1 Sometimes 2 Rarely 3 Never 4			
XS5	Fermented prawn	Very often 1 Sometimes 2 Rarely 3 Never 4			
XS6	Others	Very often 1 Sometimes 2 Rarely 3 Never 4			

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

When you eat **out** (restaurant or social gathering occasions), how often do you add salt into your food (write in relevant box)					
		Frequency	**Breakfast**	**Lunch**	**Dinner**
XS7	Fish sauce, soy sauce, manufactured sauce	Very often 1 Sometimes 2 Rarely 3 Never 4			
XS8	Home-made sauce from salt	Very often 1 Sometimes 2 Rarely 3 Never 4			
XS9	Salt	Very often 1 Sometimes 2 Rarely 3 Never 4			
XS10	MSG	Very often 1 Sometimes 2 Rarely 3 Never 4			
XS11	Fermented prawn	Very often 1 Sometimes 2 Rarely 3 Never 4			
XS12	Others	Very often 1 Sometimes 2 Rarely 3 Never 4			

Physical activity

Next I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person.

	Question	Answer	Code
Work activity In the last 12 months, you may have only one main work or have work that varies with seasons or month of the year. Please think about the main work activities in the last 12 months and answer the following questions.			
XP0 *XP0a*	Please tell me the main types of work you did in the last 12 months and the number of months spent for each type **Work 1:**	Number of months in a year	— —
XP0b	*If there is more than one type, ask the second types and number of months spent on that work* **Work 2**:	Number of months in a year	— —
P1	***Now I will ask you about the first main work you did in the last 12 months*** *(use name of work 1)* Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate (like *carrying or lifting heavy loads, digging or construction work)* for at least 10 minutes continuously? *(give examples, use SHOWCARD)*	Yes 1 No 2 *If no go to P4*	
P2	In a typical week, on how many days do you do vigorous-intensity activities as part of your work?	Number of days	____
P3	How much time do you spend doing vigorous-intensity activities at work on a typical day?	Duration	___ ___ Hour min
P4	Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking or *carrying light loads* for at least 10 minutes continuously? *(give examples, use SHOWCARD)*	Yes 1 No 2 *If no, go to XP1*	

P5	In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Number of days	____
P6	How much time do you spend doing moderate-intensity activities at work on a typical day?	Duration	___ ___ Hour min
XP1	***If participant gives 2 types of work for P0, interviewer continues to ask question XP1. Otherwise, go to P7*** Beside the months you spent on the type of work that we already discussed, now I will ask you about the other main type of work you did in the rest of the year *(use name of work 2)* Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate (like *carrying or lifting heavy loads, digging or construction work)* for at least 10 minutes continuously? *(give examples, use SHOWCARD)*	Yes 1 No 2 *If no, go to XP4*	
XP2	In a typical week, on how many days do you do vigorous-intensity activities as part of your work?	Number of days	____
XP3	How much time do you spend doing vigorous-intensity activities at work on a typical day?	Duration	___ ___ Hour min
XP4	Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking or *carrying light loads* for at least 10 minutes continuously? *(give examples, use SHOWCARD)*	Yes 1 No 2 *If no, go to P7*	
XP5	In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Number of days	____
XP6	How much time do you spend doing moderate-intensity activities at work on a typical day?	Duration	___ ___ Hour min

Travel to and from places			
Beside the activities already mention above, now I will ask you about your usual way of traveling from place to place, in the last 12 months, such as to work, for shopping, to market, to place of workship.			
P7	Do you walk or use a bicycle *(pedal cycle)* for at least 10 minutes continuously to get to and from places?	Yes 1 No 2 *If no, go to X P10*	
P8	In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?	Number of days	__ __
P9	How much time do you spend walking or bicycling for travel on a typical day?	Duration	___ ___ Hour min

Recreational activities			
Now I would like to ask you about your recreational activities in the last 12 months. The following questions exclude the work and transport activities that you have already mentioned.			
XP10	In your free time, do you do any recreational physical activity? (such as running, walking, dancing, Yoga, football, badminton, etc.)? *(Give examples, use SHOWCARD)*	Yes 1 No 2 *If no, go to P16*	
P10	Do you do any vigorous-intensity sports, fitness or recreational *(leisure)* activities that cause large increases in breathing or heart rate like (*running or football* for at least 10 minutes continuously? *(Give examples, use SHOWCARD)*	Yes 1 No 2 *If no, go to P13*	
P11	In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational activities?	Number of days	___
P12	How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?	Duration	___ ___ Hour min

P13	Do you do any moderate-intensity sports, fitness or recreational *(leisure)* activities that cause a small increase in breathing or heart rate such as brisk walking *(cycling, swimming, volleyball)* for at least 10 minutes continuously? *(Give examples, use SHOWCARD)*	Yes 1 No 2 *If no, go to P16*	
P14	In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational activities?	Number of days	___
P15	How much time do you spend doing moderate-intensity sports, fitness or recreational *(leisure)* activities on a typical day?	Duration	___ ___ Hour min

Sedentary behaviour			
The following question is about sitting or reclining in the last 12 months at work, at home, getting to and from places, or with friends including time spent sitting at a desk, sitting with friends, traveling in car, bus, train, reading, playing cards or watching television, lunch nap, but do not include time spent sleeping at night.			
P16	How much time do you usually spend sitting or reclining on a typical day?	Duration	___ ___ Hour min

History of Raised Blood Pressure			
Question		**Answer**	**Code**
H1	When was the last time your blood pressure was measured by a health worker?	In the last 12 months 1 1-5 years ago 2 Not in the last 5 years 3	
H2	In the last 12 months, have you been told by a health worker that you had high blood pressure?	Yes 1 No 2 *If no, go to XH5a*	
Are you currently receiving any of the following treatments/advice for high blood pressure prescribed by a doctor or other health worker?			
H3a	Drugs (medication) that you have taken in the past two weeks?	Yes 1 No 2	
H3b	Advice to reduce salt intake?	Yes 1 No 2	
H3c	Advice or treatment to lose weight	Yes 1 No 2	
H3d	Advice or treatment to stop smoking	Yes 1 No 2	
H3e	Advice to start or do more exercise	Yes 1 No 2	
H4	In the last 12 months, have you visited a traditional healer for raised blood pressure or hypertension?	Yes 1 No 2	
H5	Are you currently taking any herbal or traditional remedy for your raised blood pressure?	Yes 1 No 2	
XH5a	In your family, is there any person who has been diagnosed with hypertension (grandparents, parents, siblings, and children)?	Yes 1 No 2 *If no, go to H6*	
XH5b	If yes, specify who	....	

History of diabetes			
Question		Answer	Code
H6	In the last 12 months, have you had your blood sugar level measured?	Yes 1 No 2	
H7	I have ever been told by a health worker that you have diabetes?	Yes 1 No 2 *If no, go to XH11*	
XH8	Are you currently receiving any treatment for diabetes?	Yes 1 No 2 *If no, go to XH11*	
Are you currently receiving any of the following treatments/advice for diabetes prescribed by a doctor or other health worker?			
H8a	Insulin	Yes 1 No 2	
H8b	Drugs (medication) that you have taken in the past two weeks	Yes 1 No 2	
H8c	Special prescribed diet	Yes 1 No 2	
H8d	Advice or treatment to lose weight	Yes 1 No 2	
H8e	Advice or treatment to stop smoking	Yes 1 No 2	
H8f	Advice to start or do more exercise	Yes 1 No 2	
H9	In the last 12 months, have you visited a traditional healer for diabetes?	Yes 1 No 2	
H10	Are you currently taking any herbal or traditional remedy for your diabetes?	Yes 1 No 2	
XH11	In your family, is there any person who has been diagnosed with diabetes (grandparents, parents, siblings, and children)?	Yes 1 No 2 *If no, go to XO1*	
XH12	If yes, specify:	....	

	Other information		
XO1	**<u>For women only:</u>** are you currently taking any oral contraceptive pill?	Yes 1 No 2	
XO2	Are you currently taking any other medication?	Yes 1 No 2 *If no, go to XI9.*	
XO3	**<u>If yes</u>**: specify name of medication and condition treated (exclude oral contraceptive pill)?	Name of medication ………………………. ……………………….	Condition treated ………………………. ……………………….
XI9	Time finish interview	— — : — — Hour minute	

Step 2 Physical measurement

Height and weight		Answer	Code
M1	Technician ID	ID	__ __
M2a	Stadiometer ID	ID	__ __
M2b	Scale ID	ID	__ __
M3	Height	cm	__ __ __ , __
M4	Weight *If too big for scale: write 666.6*	kg	__ __ __ , __
Waist / hip circumference			
M5	**<u>For women only</u>**: are you pregnant?	Yes 1 No 2 *If yes, go to M8*	
M6	Tape measure ID	ID	__ __
M7	Waist circumference	cm	__ __ __ , __
XM7	Hip circumference	cm	__ __ __ , __
Blood pressure			
M8	Techinician ID	ID	__ __
M9	Blood pressure machine ID	ID	__ __
XM10	Arm circumference	______cm	
M10	Cuff size	Small (17-21cm) 1 Medium (22-31cm) 2 Large (32-42cm) 3	
M11a M11b	Reading 1	Systolic (mmHg) Diastolic (mmHg)	__ __ __ __ __ __
M12a M12b	Reading 2	Systolic (mmHg) Diastolic (mmHg)	__ __ __ __ __ __
M13a M13b	Reading 3	Systolic (mmHg) Diastolic (mmHg)	__ __ __ __ __ __
M14	During the past two weeks, have you been treated for raised blood pressure with drugs (medication) prescribed by a doctor or other health worker?	Yes 1 No 2	

Step 3 Biochemical measurements			
Blood glucose		**Answer**	**Code**
B1	During the past 8 hours have you had anything to eat or drink, other than water?	Yes 1 No 2	
B2	Technician ID	ID	__ __ __
B3	Glucometer ID	ID	__ __ __
B4	Time of day blood specimen taken (24 hour clock)		__ __ : __ __ hour minute
B5	Fasting blood glucose	mmol/L	__ __ , __ __
XB5	If glucose meter shows reading as low or high, report the reading	Low 1 High 2 Unable to measure 3	
Blood cholesterol			
B6	Glucometer ID	ID	__ __
B7	Total cholesterol	mmol/L	__ __ , __ __
XB7	If glucose meter shows reading as low or high, report the reading	Low 1 High 2 Unable to measure 3	
Urine sample collection			
XU1	Urine collection required	Yes1 No2	

Full name, signature of data collection staff

Interviewer	Anthropometry technician	Blood pressure technician	Blood chemistry technician	Urine collector

Field supervisor

Appendix 7.B

WHO STEPS instrument

Following is the original WHO STEPS instrument on which the Vietnam NCD Risk Factor Survey 2009−2010 STEPS instrument is based (see Appendix 8.A)

WHO STEPS Instrument

(Core and Expanded)

The WHO STEPwise approach to chronic disease risk factor surveillance (STEPS)

World Health Organization

20 Avenue Appia, 1211 Geneva 27, Switzerland

For further information: www.who.int/chp/steps

World Health Organization

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

STEPS Instrument

Overview

Introduction

This is the generic STEPS Instrument which sites/countries will use to develop their tailored instrument. It contains the:

- CORE items (unshaded boxes)
- EXPANDED items (shaded boxes).

Core Items

The Core items for each section ask questions required to calculate basic variables. For example:

- current daily smokers
- mean BMI.
-

Note: All the core questions should be asked, removing core questions will impact the analysis.

Expanded items

The Expanded items for each section ask more detailed information. Examples include:

- use of smokeless tobacco
- sedentary behaviour.

Guide to the columns

The table below is a brief guide to each of the columns in the Instrument.

Column	Description	Site Tailoring
Number	This question reference number is designed to help interviewers find their place if interrupted.	Renumber the instrument sequentially once the content has been finalized.
Question	Each question is to be read to the participants	• Select sections to use. • Add expanded and optional questions as desired.
Response	This column lists the available response options which the interviewer will be circling or filling in the text boxes. The skip instructions are shown on the right hand side of the responses and should be carefully followed during interviews.	• Add site specific responses for demographic responses (e.g. C6). • Change skip question identifiers from code to question number.
Code	The column is designed to match data from the instrument into the data entry tool, data analysis syntax, data book, and fact sheet.	This should never be changed or removed. The code is used as a general identifier for the data entry and analysis.

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

WHO STEPS Instrument
for Chronic Disease Risk Factor Surveillance

<insert country/site name>

Survey Information

Location and Date		Response	Code
1	Cluster/Centre/Village ID	└─┴─┴─┘	I1
2	Cluster/Centre/Village name		I2
3	Interviewer ID	└─┴─┴─┘	I3
4	Date of completion of the instrument	└─┴─┘ └─┴─┘ └─┴─┴─┴─┘ dd mm year	I4

Participant Id Number └─┴─┴─┘ └─┴─┴─┘ └─┴─┴─┘

Consent, Interview Language and Name		Response	Code
5	Consent has been read and obtained	Yes 1 No 2 **If NO, END**	I5
6	Interview Language [Insert Language]	English 1 *[Add others]* 2 *[Add others]* 3 *[Add others]* 4	I6
7	Time of interview (24 hour clock)	└─┴─┘ : └─┴─┘ hrs mins	I7
8	Family Surname		I8
9	First Name		I9
Additional Information that may be helpful			
10	Contact phone number where possible		I10

Record and file identification information (I5 to I10) separately from the completed questionnaire

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

Step 1 Demographic Information

CORE: Demographic Information			
Question		**Response**	**Code**
11	Sex (*Record Male / Female as observed*)	Male 1 Female 2	C1
12	What is your date of birth? *Don't Know 77 77 7777*	└─┴─┘ └─┴─┘ └─┴─┴─┴─┘ *If known, Go to C4* dd mm year	C2
13	How old are you?	Years └─┴─┘	C3
14	In total, how many years have you spent at school or in full-time study (excluding pre-school)?	Years └─┴─┘	C4
EXPANDED: Demographic Information			
15	What is the **highest level of education** you have completed? *[INSERT COUNTRY-SPECIFIC CATEGORIES]*	No formal schooling 1 Less than primary school 2 Primary school completed 3 Secondary school completed 4 High school completed 5 College/University completed 6 Post graduate degree 7 Refused 88	C5
16	What is your *[insert relevant ethnic group / racial group / cultural subgroup / others]* **background**?	*[Locally defined]* 1 *[Locally defined]* 2 *[Locally defined]* 3 Refused 88	C6
17	What is your **marital status**?	Never married 1 Currently married 2 Separated 3 Divorced 4 Widowed 5 Cohabitating 6 Refused 88	C7
18	Which of the following best describes your **main work** status over the past 12 months? *[INSERT COUNTRY-SPECIFIC CATEGORIES]* *(USE SHOWCARD)*	Government employee 1 Non-government employee 2 Self-employed 3 Non-paid 4 Student 5 Homemaker 6 Retired 7 Unemployed (able to work) 8 Unemployed (unable to work) 9 Refused 88	C8
19	How many people older than 18 years, including yourself, live in your household?	Number of people └─┴─┘	C9

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT
☐	☐☐	☐☐☐

EXPANDED: Demographic Information, Continued			
Question		**Response**	**Code**
20	Taking **the past year**, can you tell me what the average earnings of the household have been? *(RECORD ONLY ONE, NOT ALL 3)*	Per week └─┴─┴─┴─┴─┴─┴─┘ *Go to T1*	C10a
		OR per month └─┴─┴─┴─┴─┴─┴─┘ *Go to T1*	C10b
		OR per year └─┴─┴─┴─┴─┴─┴─┘ *Go to T1*	C10c
		Refused 88	C10d
21	If you don't know the amount, can you give an **estimate** of the annual household income if I read some options to you? Is it *[INSERT QUINTILE VALUES IN LOCAL CURRENCY]* *(READ OPTIONS)*	≤ Quintile (Q) 1 — 1 More than Q 1, ≤ Q 2 — 2 More than Q 2, ≤ Q 3 — 3 More than Q 3, ≤ Q 4 — 4 More than Q 4 — 5 Don't Know — 77 Refused — 88	C11

Step 1 Behavioural Measurements

CORE: Tobacco Use			
Now I am going to ask you some questions about various health behaviours. This includes things like smoking, drinking alcohol, eating fruits and vegetables and physical activity. Let's start with tobacco.			
Question		**Response**	**Code**
22	Do you currently smoke any **tobacco products**, such as cigarettes, cigars or pipes? *(USE SHOWCARD)*	Yes 1 No 2 *If No, go to T6*	T1
23	Do you currently smoke tobacco products **daily**?	Yes 1 No 2 *If No, go to T6*	T2
24	How old were you when you **first started** smoking daily?	Age (years) Don't know 77 └─┴─┘ *If Known, go to T5a*	T3
25	Do you remember how long ago it was? *(RECORD ONLY 1, NOT ALL 3)* *Don't know 77*	In Years └─┴─┘ *If Known, go to T5a*	T4a
		OR in Months └─┴─┘ *If Known, go to T5a*	T4b
		OR in Weeks └─┴─┘	T4c
26	On average, **how many** of the following do you smoke each day? *(RECORD FOR EACH TYPE, USE SHOWCARD)* *Don't Know 77*	Manufactured cigarettes └─┴─┘	T5a
		Hand-rolled cigarettes └─┴─┘	T5b
		Pipes full of tobacco └─┴─┘	T5c
		Cigars, cheroots, cigarillos └─┴─┘	T5d
		Other └─┴─┘ *If Other, go to T5other, else go to T9*	T5e
		Other (please specify): └─┴─┴─┴─┴─┴─┘ *Go to T9*	T5other

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

EXPANDED: Tobacco Use

	Question	Response	Code
27	In the past, did you **ever** smoke **daily**?	Yes 1 No 2 *If No, go to T9*	T6
28	How old were you when you **stopped** smoking **daily**?	Age (years) Don't Know 77 └┴┘ *If Known, go to T9*	T7
29	How **long ago** did you stop smoking daily? *(RECORD ONLY 1, NOT ALL 3)* *Don't Know 77*	Years ago └┴┘ *If Known, go to T9*	T8a
		OR Months ago └┴┘ *If Known, go to T9*	T8b
		OR Weeks ago └┴┘	T8c
30	Do you **currently use** any **smokeless tobacco** such as *[snuff, chewing tobacco, betel]*? *(USE SHOWCARD)*	Yes 1 No 2 *If No, go to T12*	T9
31	Do you **currently use smokeless tobacco** products **daily?**	Yes 1 No 2 *If No, go to T12*	T10
32	On average, how many **times a day** do you use …. *(RECORD FOR EACH TYPE, USE SHOWCARD)* *Don't Know 77*	Snuff, by mouth └┴┘	T11a
		Snuff, by nose └┴┘	T11b
		Chewing tobacco └┴┘	T11c
		Betel, quid └┴┘	T11d
		Other └┴┘ *If Other, go to T11other, else go to T13*	T11e
		Other (specify) └┴┴┴┴┴┴┘ *Go to T13*	T11other
33	In the **past**, did you **ever use** smokeless tobacco such as *[snuff, chewing tobacco, or betel]* **daily**?	Yes 1 No 2	T12
34	During the past 7 days, on how many days did someone **in your home** smoke when you were present?	Number of days Don't know 77 └┴┘	T13
35	During the past 7 days, on how many days did someone smoke in closed areas **in your workplace** (in the building, in a work area or a specific office) when you were present?	Number of days Don't know or don't work in a closed area 77 └┴┘	T14

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

CORE: Alcohol Consumption			
The next questions ask about the consumption of alcohol.			
Question		**Response**	**Code**
36	Have you **ever** consumed an alcoholic drink such as beer, wine, spirits, fermented cider or *[add other local examples]*? *(USE SHOWCARD OR SHOW EXAMPLES)*	Yes 1 No 2 *If No, go to D1*	A1a
37	Have you consumed an alcoholic drink within the **past 12 months**?	Yes 1 No 2 *If No, go to D1*	A1b
38	During the past 12 months, **how frequently** have you had at least one alcoholic drink? *(READ RESPONSES, USE SHOWCARD)*	Daily 1 5-6 days per week 2 1-4 days per week 3 1-3 days per month 4 Less than once a month 5	A2
39	Have you consumed an alcoholic drink within the **past 30 days**?	Yes 1 No 2 *If No, go to D1*	A3
40	During the past 30 days, on how many **occasions** did you have at least one alcoholic drink?	Number Don't know 77 └─┴─┘	A4
41	During the past 30 days, when you drank alcohol, **on average**, how many **standard alcoholic drinks** did you have during one drinking occasion? *(USE SHOWCARD)*	Number Don't know 77 └─┴─┘	A5
42	During the past 30 days, what was the **largest number** of standard alcoholic drinks you had on a single occasion, counting all types of alcoholic drinks together?	Largest number Don't Know 77 └─┴─┘	A6
43	During the past 30 days, how many times did you have for **men**: **five or more** for **women**: **four or more** standard alcoholic drinks in a single drinking occasion?	Number of times Don't Know 77 └─┴─┘	A7

EXPANDED: Alcohol Consumption			
44	During the past 30 days, when you consumed an alcoholic drink, how often was it with meals? Please do not count snacks.	Usually with meals 1 Sometimes with meals 2 Rarely with meals 3 Never with meals 4	A8
45	During each of the **past 7 days**, how many standard alcoholic drinks did you have each day? *(USE SHOWCARD)* *Don't Know 77*	Monday └─┴─┘	A9a
		Tuesday └─┴─┘	A9b
		Wednesday └─┴─┘	A9c
		Thursday └─┴─┘	A9d
		Friday └─┴─┘	A9e
		Saturday └─┴─┘	A9f
		Sunday └─┴─┘	A9g

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

CORE: Diet			
The next questions ask about the fruits and vegetables that you usually eat. I have a nutrition card here that shows you some examples of local fruits and vegetables. Each picture represents the size of a serving. As you answer these questions please think of a typical week in the last year.			
Question		**Response**	**Code**
46	In a typical week, on how many days do you **eat fruit**? *(USE SHOWCARD)*	Number of days └─┴─┘ Don't Know 77 *If Zero days, go to D3*	D1
47	How many **servings** of fruit do you eat on **one** of those days? *(USE SHOWCARD)*	Number of servings Don't Know 77 └─┴─┘	D2
48	In a typical week, on how many days do you **eat vegetables**? *(USE SHOWCARD)*	Number of days └─┴─┘ Don't Know 77 *If Zero days, go to D5*	D3
49	How many **servings** of vegetables do you eat on one of those days? *(USE SHOWCARD)*	Number of servings Don't know 77 └─┴─┘	D4

EXPANDED: Diet			
50	What type of **oil or fat is most often** used for meal preparation in your household? *(USE SHOWCARD)* *(SELECT ONLY ONE)*	Vegetable oil 1 Lard or suet 2 Butter or ghee 3 Margarine 4 Other 5 *If Other, go to D5 other* None in particular 6 None used 7 Don't know 77	D5
		Other └─┴─┴─┴─┴─┴─┴─┘	D5other
51	On average, how many meals per week do you eat that were not prepared at a home? By meal, I mean breakfast, lunch and dinner.	Number Don't know 77 └─┴─┘	D6

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

CORE: Physical Activity			
Next I am going to ask you about the time you spend doing different types of physical activity in a typical week. Please answer these questions even if you do not consider yourself to be a physically active person. Think first about the time you spend doing work. Think of work as the things that you have to do such as paid or unpaid work, study/training, household chores, harvesting food/crops, fishing or hunting for food, seeking employment. *[Insert other examples if needed].* In answering the following questions 'vigorous-intensity activities' are activities that require hard physical effort and cause large increases in breathing or heart rate, 'moderate-intensity activities' are activities that require moderate physical effort and cause small increases in breathing or heart rate.			
Question		**Response**	**Code**
Work			
52	Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like *[carrying or lifting heavy loads, digging or construction work]* for at least 10 minutes continuously? *[INSERT EXAMPLES] (USE SHOWCARD)*	Yes 1 No 2 *If No, go to P 4*	P1
53	In a typical week, on how many days do you do vigorous-intensity activities as part of your work?	Number of days └─┘	P2
54	How much time do you spend doing vigorous-intensity activities at work on a typical day?	Hours : minutes └─┴─┘ : └─┴─┘ hrs mins	P3 (a-b)
55	Does your work involve moderate-intensity activity, that causes small increases in breathing or heart rate such as brisk walking *[or carrying light loads]* for at least 10 minutes continuously? *[INSERT EXAMPLES] (USE SHOWCARD)*	Yes 1 No 2 *If No, go to P 7*	P4
56	In a typical week, on how many days do you do moderate-intensity activities as part of your work?	Number of days └─┘	P5
57	How much time do you spend doing moderate-intensity activities at work on a typical day?	Hours : minutes └─┴─┘ : └─┴─┘ hrs mins	P6 (a-b)
Travel to and from places			
The next questions exclude the physical activities at work that you have already mentioned. Now I would like to ask you about the usual way you travel to and from places. For example to work, for shopping, to market, to place of worship. *[Insert other examples if needed]*			
58	Do you walk or use a bicycle *(pedal cycle)* for at least 10 minutes continuously to get to and from places?	Yes 1 No 2 *If No, go to P 10*	P7
59	In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?	Number of days └─┘	P8
60	How much time do you spend walking or bicycling for travel on a typical day?	Hours : minutes └─┴─┘ : └─┴─┘ hrs mins	P9 (a-b)

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

CORE: Physical Activity, Continued			
Question		**Response**	**Code**
Recreational activities			
The next questions exclude the work and transport activities that you have already mentioned. Now I would like to ask you about sports, fitness and recreational activities (leisure), *[Insert relevant terms]*.			
61	Do you do any vigorous-intensity sports, fitness or recreational *(leisure)* activities that cause large increases in breathing or heart rate like *[running or football]* for at least 10 minutes continuously? *[INSERT EXAMPLES] (USE SHOWCARD)*	Yes 1 No 2 *If No, go to P 13*	P10
62	In a typical week, on how many days do you do vigorous-intensity sports, fitness or recreational *(leisure)* activities?	Number of days └─┘	P11
63	How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?	Hours : minutes └─┴─┘ : └─┴─┘ hrs mins	P12 (a-b)
64	Do you do any moderate-intensity sports, fitness or recreational *(leisure)* activities that cause a small increase in breathing or heart rate such as brisk walking, *[cycling, swimming, volleyball]* for at least 10 minutes continuously? *[INSERT EXAMPLES] (USE SHOWCARD)*	Yes 1 No 2 *If No, go to P16*	P13
65	In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational *(leisure)* activities?	Number of days └─┘	P14
66	How much time do you spend doing moderate-intensity sports, fitness or recreational *(leisure)* activities on a typical day?	Hours : minutes └─┴─┘ : └─┴─┘ hrs mins	P15 (a-b)

EXPANDED: Physical Activity			
Sedentary behaviour			
The following question is about sitting or reclining at work, at home, getting to and from places, or with friends including time spent sitting at a desk, sitting with friends, traveling in car, bus, train, reading, playing cards or watching television, but do not include time spent sleeping. *[INSERT EXAMPLES] (USE SHOWCARD)*			
67	How much time do you usually spend sitting or reclining on a typical day?	Hours : minutes └─┴─┘ : └─┴─┘ hrs mins	P16 (a-b)

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

CORE: History of Raised Blood Pressure			
Question		**Response**	**Code**
68	Have you ever had your blood pressure measured by a doctor or other health worker?	Yes 1 No 2 *If No, go to H6*	H1
69	Have you ever been told by a doctor or other health worker that you have raised blood pressure or hypertension?	Yes 1 No 2 *If No, go to H6*	H2a
70	Have you been told in the past 12 months?	Yes 1 No 2	H2b

EXPANDED: History of Raised Blood Pressure			
71	Are you currently receiving any of the following treatments/advice for high blood pressure prescribed by a doctor or other health worker?		
	Drugs (medication) that you have taken in the past two weeks	Yes 1 No 2	H3a
	Advice to reduce salt intake	Yes 1 No 2	H3b
	Advice or treatment to lose weight	Yes 1 No 2	H3c
	Advice or treatment to stop smoking	Yes 1 No 2	H3d
	Advice to start or do more exercise	Yes 1 No 2	H3e
72	Have you ever seen a traditional healer for raised blood pressure or hypertension?	Yes 1 No 2	H4
73	Are you currently taking any herbal or traditional remedy for your raised blood pressure?	Yes 1 No 2	H5

Participant's ID

PROVINCE	COMMUNE	PARTICIPANT

CORE: History of Diabetes

Question		Response	Code
74	Have you ever had your blood sugar measured by a doctor or other health worker?	Yes 1 No 2 *If No, go to M1*	H6
75	Have you ever been told by a doctor or other health worker that you have raised blood sugar or diabetes?	Yes 1 No 2 *If No, go to M1*	H7a
76	Have you been told in the past 12 months?	Yes 1 No 2	H7b

EXPANDED: History of Diabetes

77	Are you currently receiving any of the following treatments/advice for diabetes prescribed by a doctor or other health worker?		
	Insulin	Yes 1 No 2	H8a
	Drugs (medication) that you have taken in the past two weeks	Yes 1 No 2	H8b
	Special prescribed diet	Yes 1 No 2	H8c
	Advice or treatment to lose weight	Yes 1 No 2	H8d
	Advice or treatment to stop smoking	Yes 1 No 2	H8e
	Advice to start or do more exercise	Yes 1 No 2	H8f
78	Have you ever seen a traditional healer for diabetes or raised blood sugar?	Yes 1 No 2	H9
79	Are you currently taking any herbal or traditional remedy for your diabetes?	Yes 1 No 2	H10

Step 2 Physical Measurements

CORE: Height and Weight			
Question		**Response**	**Code**
80	Interviewer ID	└─┴─┴─┘	M1
81	Device IDs for height and weight	Height └─┴─┘ Weight └─┴─┘	M2a M2b
82	Height	in Centimetres (cm) └─┴─┴─┘.└─┘	M3
83	Weight *If too large for scale 666.6*	in Kilograms (kg) └─┴─┴─┘.└─┘	M4
84	**For women:** Are you pregnant?	Yes 1 *If Yes, go to M 8* No 2	M5
CORE: Waist			
85	Device ID for waist	└─┴─┘	M6
86	Waist circumference	in Centimetres (cm) └─┴─┴─┘.└─┘	M7
CORE: Blood Pressure			
87	Interviewer ID	└─┴─┴─┘	M8
88	Device ID for blood pressure	└─┴─┘	M9
89	Cuff size used	Small 1 Medium 2 Large 3	M10
90	Reading 1	Systolic (mmHg) └─┴─┴─┘	M11a
		Diastolic (mmHg) └─┴─┴─┘	M11b
91	Reading 2	Systolic (mmHg) └─┴─┴─┘	M12a
		Diastolic (mmHg) └─┴─┴─┘	M12b
92	Reading 3	Systolic (mmHg) └─┴─┴─┘	M13a
		Diastolic (mmHg) └─┴─┴─┘	M13b
93	During the past two weeks, have you been treated for raised blood pressure with drugs (medication) prescribed by a doctor or other health worker?	Yes 1 No 2	M14

EXPANDED: Hip Circumference and Heart Rate				
94	Hip circumference	in Centimeters (cm)	└─┴─┴─┘.└─┘	M15
95	Heart Rate			
	Reading 1	Beats per minute	└─┴─┴─┘	M16a
	Reading 2	Beats per minute	└─┴─┴─┘	M16b
	Reading 3	Beats per minute	└─┴─┴─┘	M16c

Step 3 Biochemical Measurements

CORE: Blood Glucose				
Question		**Response**		**Code**
96	During the past 12 hours have you had anything to eat or drink, other than water?	Yes No	1 2	B1
97	Technician ID		└─┴─┴─┘	B2
98	Device ID		└─┴─┘	B3
99	Time of day blood specimen taken (24 hour clock)	Hours : minutes	└─┴─┘ : └─┴─┘ hrs mins	B4
100	Fasting blood glucose *Choose accordingly: mmol/l or mg/dl*	mmol/l	└─┴─┘.└─┴─┘	B5
		mg/dl	└─┴─┴─┘.└─┘	
101	Today, have you taken insulin or other drugs (medication) that have been prescribed by a doctor or other health worker for raised blood glucose?	Yes No	1 2	B6
CORE: Blood Lipids				
102	Device ID		└─┴─┘	B7
103	Total cholesterol *Choose accordingly: mmol/l or mg/dl*	mmol/l	└─┴─┘.└─┴─┘	B8
		mg/dl	└─┴─┴─┘.└─┘	
104	During the past two weeks, have you been treated for raised cholesterol with drugs (medication) prescribed by a doctor or other health worker?	Yes No	1 2	B9

EXPANDED: Triglycerides and HDL Cholesterol				
105	Triglycerides *Choose accordingly: mmol/l or mg/dl*	mmol/l	└─┴─┘.└─┴─┘	B10
		mg/dl	└─┴─┴─┘.└─┘	
106	HDL Cholesterol *Choose accordingly: mmol/l or mg/dl*	mmol/l	└─┘.└─┴─┘	B11
		mg/dl	└─┴─┴─┘.└─┘	

Appendix 8

Visual aids for a standard drink, a standard serving of fruit and vegetables, and physical activity

Showcards for a standard drink (10 grams of alcohol)

30 ml of spirit (home-made product) – 40% Alc. Vol.

120 ml of red wine – 11% Alc. Vol.

285 ml glass: Ha Noi Bia – 4.5% Alc. Vol.

Showcards for a standard serving

Two small custard apples

1/2 dragon fruit

1/2 bowl of cooked vegetables

Showcards for physical activity

Vigorous work activities

Moderate work activity

Vigorous activities at leisure time

Appendix 9

Prevalence of NCD risk factors in Vietnam − national and provincial estimates

Table 1. Smoking status of participants in the Vietnam STEPS survey

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Never	151	35.3 ± 6.0	148	25.9 ± 3.5	142	23.6 ± 4.3	202	29.1 ± 3.7	643	29.0 ± 2.6
	Ex-smoker	44	10.9 ± 3.1	114	18.3 ± 3.4	152	23.1 ± 3.8	180	25.3 ± 3.8	490	17.6 ± 1.8
	Current non-daily	23	6.5 ± 2.9	17	3.1 ± 1.4	11	1.7 ± 1.1	19	2.6 ± 1.3	70	3.9 ± 1.2
	Current daily	209	47.2 ± 6.7	315	52.7 ± 4.5	326	51.6 ± 4.4	307	43.0 ± 5.0	1157	49.5 ± 3.0
	Rural										
	Never	349	33.1 ± 3.8	219	16.0 ± 3.2	243	20.3 ± 4.4	269	19.1 ± 3.7	1080	23.4 ± 2.0
	Ex-smoker	120	11.3 ± 2.9	193	17.4 ± 2.6	246	22.3 ± 3.5	298	24.1 ± 3.8	857	17.1 ± 1.6
	Current non-daily	42	2.9 ± 1.5	21	2.4 ± 1.3	15	1.5 ± 1.3	18	2.1 ± 1.4	96	2.3 ± 0.8
	Current daily	481	52.7 ± 4.3	634	64.3 ± 3.5	654	56.0 ± 4.8	620	54.7 ± 5.5	2389	57.2 ± 2.2
	Total										
	Never	500	33.7 ± 3.2	367	18.9 ± 2.5	385	21.3 ± 3.3	471	22.0 ± 2.8	1723	25.1 ± 1.6
	Ex-smoker	164	11.2 ± 2.2	307	17.7 ± 2.1	398	22.5 ± 2.7	478	24.5 ± 2.9	1347	17.2 ± 1.2
	Current non-daily	65	4.0 ± 1.4	38	2.6 ± 1.0	26	1.5 ± 1.0	37	2.2 ± 1.0	166	2.8 ± 0.6
	Current daily	690	51.1 ± 3.6	949	60.9 ± 2.8	980	54.6 ± 3.6	927	51.3 ± 4.1	3546	54.9 ± 1.8
Women	*Urban*										
	Never	526	97.4 ± 1.4	680	97.4 ± 1.3	781	98 ± 0.9	741	96.1 ± 1.3	2728	97.4 ± 0.7
	Ex-smoker	5	1.3 ± 1.2	6	0.9 ± 0.8	5	0.7 ± 0.6	16	1.4 ± 0.8	32	1.1 ± 0.5
	Current non-daily	1	0.2 ± 0.3	1	0.1 ± 0.3	0	0.0 ± 0.0	2	0.2 ± 0.3	4	0.1 ± 0.1
	Current daily	6	1.1 ± 0.9	12	1.5 ± 0.9	13	1.3 ± 0.8	20	2.2 ± 1.0	51	1.4 ± 0.5
	Rural										
	Never	1194	99.1 ± 0.6	1198	98.3 ± 0.9	1273	96.4 ± 1.6	1158	92.4 ± 2.0	4823	97.4 ± 0.6
	Ex-smoker	4	0.4 ± 0.4	8	0.5 ± 0.6	11	0.7 ± 0.9	46	2.7 ± 1.2	69	0.8 ± 0.4
	Current non-daily	0	0.0 ± 0.0	0	0.0 ± 0.0	4	0.1 ± 0.2	4	0.2 ± 0.2	8	0.0 ± 0.1
	Current daily	7	0.4 ± 0.4	17	1.2 ± 0.6	57	2.8 ± 1.2	90	4.8 ± 1.4	171	1.8 ± 0.4
	Total										
	Never	1720	98.6 ± 0.6	1878	98 ± 0.8	2054	96.9 ± 1.2	1899	93.5 ± 1.4	7551	97.4 ± 0.5
	Ex-smoker	9	0.7 ± 0.5	14	0.6 ± 0.5	16	0.7 ± 0.7	62	2.3 ± 0.9	101	0.9 ± 0.3
	Current non-daily	1	0.1 ± 0.1	1	0.0 ± 0.1	4	0.1 ± 0.1	6	0.2 ± 0.2	12	0.1 ± 0.1
	Current daily	13	0.7 ± 0.4	29	1.3 ± 0.5	70	2.3 ± 0.9	110	4.0 ± 1.0	222	1.7 ± 0.3

Table 2. Alcohol consumption of participants in the Vietnam STEPS survey

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Ever consume alc.	363	83.1 ± 4.9	511	83.6 ± 3.9	524	83.0 ± 3.5	543	76.1 ± 3.1	1941	82.5 ± 2.3
	Consumed last 12ms	352	80.2 ± 4.9	491	79.6 ± 4.1	498	79.0 ± 3.8	490	68.1 ± 3.1	1831	78.5 ± 2.3
	Hazardous drinking*	108	24.1 ± 5.0	128	22.5 ± 3.9	120	18.3 ± 3.1	80	11.2 ± 3.0	436	20.9 ± 2.3
	Harmful drinking†	112	23.7 ± 4.9	124	18.6 ± 4.3	110	17.5 ± 3.5	78	10.2 ± 2.9	424	19.3 ± 2.4
	Rural										
	Ever consume alc.	863	85.0 ± 4.7	929	87.9 ± 2.8	989	83.8 ± 4.0	979	79.8 ± 3.4	3760	85.1 ± 2.1
	Consumed last 12ms	839	82.1 ± 4.8	900	84.5 ± 3.1	945	79.8 ± 3.4	871	71.3 ± 3.5	3555	81.2 ± 2.2
	Hazardous drinking*	169	14.2 ± 2.2	162	17.3 ± 4.5	183	13.1 ± 2.5	154	13.5 ± 3.1	668	14.8 ± 1.7
	Harmful drinking†	301	28.7 ± 4.1	326	28.0 ± 3.6	312	25.1 ± 3.4	189	14.0 ± 2.7	1128	26.1 ± 2.0
	Total										
	Ever consume alc.	1226	84.5 ± 3.6	1440	86.6 ± 2.3	1513	83.5 ± 2.9	1522	78.7 ± 2.6	5701	84.3 ± 1.6
	Consumed last 12ms	1191	81.6 ± 3.7	1391	83.1 ± 2.5	1443	79.6 ± 2.6	1361	70.4 ± 2.7	5386	80.4 ± 1.7
	Hazardous drinking*	277	17.1 ± 2.1	290	18.8 ± 3.4	303	14.7 ± 2.0	234	12.8 ± 2.4	1104	16.6 ± 1.4
	Harmful drinking†	413	27.2 ± 3.2	450	25.2 ± 2.9	422	22.8 ± 2.6	267	12.9 ± 2.1	1552	24.1 ± 1.6
Women	*Urban*										
	Ever consume alc.	97	19.1 ± 4.3	107	14.6 ± 3.3	120	14.5 ± 3.3	106	12.7 ± 2.6	430	15.9 ± 2.0
	Consumed last 12ms	86	16.1 ± 4.3	89	12.2 ± 3.1	109	13.0 ± 3.3	81	9.3 ± 2.2	365	13.4 ± 1.9
	Hazardous drinking*	18	3.2 ± 1.5	24	3.2 ± 1.3	17	1.6 ± 1.0	10	1.0 ± 0.7	69	2.6 ± 0.7
	Harmful drinking†	9	2.1 ± 1.3	5	0.7 ± 0.6	10	1.1 ± 0.7	3	0.4 ± 0.5	27	1.2 ± 0.5
	Rural										
	Ever consume alc.	151	8.5 ± 2.6	147	10.9 ± 2.9	167	10.8 ± 2.8	156	10.1 ± 2.9	621	10.0 ± 1.4
	Consumed last 12ms	125	6.9 ± 2.3	118	8.2 ± 2.5	134	8.4 ± 2.6	136	9.0 ± 2.9	513	7.9 ± 1.3
	Hazardous drinking*	28	1.4 ± 0.8	26	1.1 ± 0.7	25	1.4 ± 0.8	41	2.2 ± 1.1	120	1.4 ± 0.4
	Harmful drinking†	13	0.8 ± 0.7	6	0.6 ± 0.6	12	0.6 ± 0.7	12	0.7 ± 0.6	43	0.7 ± 0.3
	Total										
	Ever consume alc.	248	11.9 ± 2.2	254	12.0 ± 2.2	287	11.9 ± 2.2	262	10.9 ± 2.2	1051	11.8 ± 1.2
	Consumed last 12ms	211	9.8 ± 2.1	207	9.4 ± 2.0	243	9.8 ± 2.0	217	9.1 ± 2.1	878	9.6 ± 1.1
	Hazardous drinking*	46	2.0 ± 0.7	50	1.8 ± 0.6	42	1.5 ± 0.6	51	1.8 ± 0.8	189	1.8 ± 0.4
	Harmful drinking†	22	1.2 ± 0.6	11	0.6 ± 0.4	22	0.8 ± 0.5	15	0.6 ± 0.5	70	0.9 ± 0.3

[*] Hazardous drinking: ≥4 standard drinks (men), ≥2 standard drinks (women); [†] Harmful drinking: ≥6 standard drinks (men), ≥4 standard drinks (women).

Table 3. Servings of fruit and vegetable in the Vietnam STEPS survey

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5 servings/day	344	80.6 ± 4.3	456	76.8 ± 4.3	507	80.1 ± 3.6	559	78.0 ± 3.3	1866	79.1 ± 2.2
	≥ 5 servings/day	81	19.4 ± 4.3	134	23.2 ± 4.3	118	19.9 ± 3.6	145	22.0 ± 3.3	478	20.9 ± 2.2
	Rural										
	< 5 servings/day	837	83.1 ± 4.1	892	81.8 ± 3.9	977	83.4 ± 4.0	1019	83.9 ± 3.6	3725	82.9 ± 2.1
	≥ 5 servings/day	144	16.9 ± 4.1	161	18.2 ± 3.9	167	16.6 ± 4.0	167	16.1 ± 3.6	639	17.1 ± 2.1
	Total										
	< 5 servings/day	1181	82.4 ± 3.1	1348	80.3 ± 3.1	1484	82.4 ± 3.0	1578	82.2 ± 2.8	5591	81.7 ± 1.6
	≥ 5 servings/day	225	17.6 ± 3.1	295	19.7 ± 3.1	285	17.6 ± 3.0	312	17.8 ± 2.8	1117	18.3 ± 1.6
Women	*Urban*										
	< 5 servings/day	408	74.6 ± 3.8	523	74.9 ± 4.3	596	74.8 ± 3.6	607	78.4 ± 3.4	2134	75.2 ± 2.1
	≥ 5 servings/day	129	25.4 ± 3.8	174	25.1 ± 4.3	196	25.2 ± 3.6	168	21.6 ± 3.4	667	24.8 ± 2.1
	Rural										
	< 5 servings/day	1001	83.5 ± 3.9	1023	83.9 ± 4.1	1135	86.8 ± 3.1	1107	85.8 ± 3.5	4266	84.7 ± 2.0
	≥ 5 servings/day	193	16.5 ± 3.9	192	16.1 ± 4.1	193	13.2 ± 3.1	171	14.2 ± 3.5	749	15.3 ± 2.0
	Total										
	< 5 servings/day	1409	80.7 ± 2.9	1546	81.2 ± 3.1	1731	83.1 ± 2.4	1714	83.6 ± 2.7	6400	81.8 ± 1.5
	≥ 5 servings/day	322	19.3 ± 2.9	366	18.8 ± 3.1	389	16.9 ± 2.4	339	16.4 ± 2.7	1416	18.2 ± 1.5

Table 4. Physical activity levels of participants in the Vietnam STEPS survey

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Low*	135	36.4 ± 5.4	223	41.4 ± 5.0	221	35.8 ± 3.6	223	29.5 ± 4.0	802	37.0 ± 2.6
	Moderate†	113	27.5 ± 4.5	116	19.5 ± 3.7	183	29.9 ± 4.0	279	41.6 ± 3.8	691	27.2 ± 2.2
	High‡	176	36.1 ± 4.8	254	39.1 ± 5.0	226	34.2 ± 3.7	209	28.9 ± 3.0	865	35.8 ± 2.5
	Rural										
	Low*	127	25.8 ± 4.3	122	18.8 ± 4.3	168	24.2 ± 4.9	216	23.4 ± 4.5	633	23.1 ± 2.4
	Moderate†	99	15.7 ± 4.4	124	16.9 ± 4.1	163	20.8 ± 3.4	221	24.2 ± 4.1	607	18.1 ± 2.2
	High‡	768	58.5 ± 5.3	822	64.3 ± 6.2	828	54.9 ± 5.7	770	52.4 ± 4.8	3188	58.8 ± 3.0
	Total										
	Low*	262	28.9 ± 3.4	345	25.4 ± 3.4	389	27.8 ± 3.6	439	25.2 ± 3.4	1435	27.2 ± 1.8
	Moderate†	212	19.2 ± 3.4	240	17.6 ± 3.1	346	23.6 ± 2.7	500	29.3 ± 3.1	1298	20.8 ± 1.7
	High‡	944	51.9 ± 4.0	1076	56.9 ± 4.6	1054	48.5 ± 4.1	979	45.5 ± 3.5	4053	52.0 ± 2.3
Women	*Urban*										
	Low*	232	48.5 ± 4.6	259	40.4 ± 4.4	222	29.8 ± 3.6	212	27.4 ± 2.8	925	39.2 ± 2.3
	Moderate†	146	27.1 ± 3.9	239	34.7 ± 4.4	292	37.2 ± 3.9	333	44.1 ± 3.9	1010	33.7 ± 2.1
	High‡	160	24.5 ± 4.2	199	25.0 ± 4.6	282	33.0 ± 3.3	237	28.5 ± 3.6	878	27.1 ± 2.2
	Rural										
	Low*	235	36.0 ± 4.2	194	23.8 ± 3.9	180	19.7 ± 2.9	277	28.7 ± 3.6	886	27.5 ± 2.0
	Moderate†	146	21.5 ± 3.4	201	25.4 ± 3.7	267	27.5 ± 3.0	313	29.8 ± 3.4	927	25.2 ± 1.8
	High‡	823	42.4 ± 3.7	828	50.7 ± 3.5	894	52.8 ± 4.1	707	41.6 ± 2.6	3252	47.3 ± 1.9
	Total										
	Low*	467	40.0 ± 3.2	453	28.8 ± 3.1	402	22.8 ± 2.3	489	28.3 ± 2.6	1811	31.1 ± 1.6
	Moderate†	292	23.3 ± 2.6	440	28.2 ± 2.9	559	30.5 ± 2.4	646	34.0 ± 2.7	1937	27.8 ± 1.4
	High‡	983	36.7 ± 2.9	1027	43.0 ± 2.8	1176	46.8 ± 3.0	944	37.7 ± 2.1	4130	41.1 ± 1.5

* Low: < 600 MET-minutes per week; † Moderate: 600-2999 MET-minutes per week; ‡ High: 3000+ MET-minutes per week

Table 5. Body mass index of participants in the Vietnam STEPS survey

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<18.5 kg/m2	57	11.0 ± 3.7	64	11.3 ± 3.2	59	9.4 ± 3.1	95	12.4 ± 2.7	275	10.9 ± 1.8
	18.5-22.9 kg/m2	232	52.9 ± 5.6	309	48.0 ± 5.4	323	49.3 ± 4.4	358	50.8 ± 5.0	1222	50.4 ± 2.8
	23.0-24.9 kg/m2	70	17.7 ± 4.4	119	20.2 ± 4.1	127	21.5 ± 3.9	131	18.0 ± 3.6	447	19.4 ± 2.2
	25.0-29.9 kg/m2	61	16.4 ± 4.0	97	18.6 ± 3.9	111	17.8 ± 2.9	124	18.1 ± 3.8	393	17.6 ± 2.0
	30+ kg/m2	7	1.9 ± 1.4	8	1.8 ± 1.2	10	2.1 ± 1.2	5	0.6 ± 0.7	30	1.8 ± 0.7
	Rural										
	<18.5 kg/m2	169	19.0 ± 3.8	143	12.7 ± 3.2	200	15.8 ± 3.7	317	22.2 ± 2.9	829	16.7 ± 1.9
	18.5-22.9 kg/m2	673	59.7 ± 4.5	726	67.0 ± 4.4	719	58.1 ± 5.5	693	55.8 ± 3.3	2811	61.2 ± 2.5
	23.0-24.9 kg/m2	91	10.9 ± 2.6	129	12.0 ± 3.2	155	15.7 ± 2.6	113	13.3 ± 3.1	488	12.6 ± 1.5
	25.0-29.9 kg/m2	54	8.7 ± 3.7	68	8.0 ± 2.4	82	10.1 ± 2.5	81	7.9 ± 2.8	285	8.7 ± 1.6
	30+ kg/m2	8	1.7 ± 1.4	3	0.4 ± 0.5	4	0.4 ± 0.5	6	0.8 ± 0.8	21	0.9 ± 0.5
	Total										
	<18.5 kg/m2	226	16.6 ± 2.9	207	12.3 ± 2.4	259	13.8 ± 2.7	412	19.3 ± 2.2	1104	15.0 ± 1.4
	18.5-22.9 kg/m2	905	57.7 ± 3.5	1035	61.4 ± 3.5	1042	55.4 ± 4.0	1051	54.4 ± 2.7	4033	58.0 ± 1.9
	23.0-24.9 kg/m2	161	12.9 ± 2.2	248	14.4 ± 2.5	282	17.4 ± 2.2	244	14.7 ± 2.4	935	14.6 ± 1.2
	25.0-29.9 kg/m2	115	11.0 ± 2.9	165	11.1 ± 2.0	193	12.5 ± 2.0	205	10.9 ± 2.3	678	11.3 ± 1.3
	30+ kg/m2	15	1.8 ± 1.1	11	0.8 ± 0.5	14	0.9 ± 0.5	11	0.7 ± 0.6	51	1.2 ± 0.4
Women	*Urban*										
	<18.5 kg/m2	100	16.0 ± 3.4	68	9.8 ± 2.6	59	7.3 ± 2.3	59	7.1 ± 1.8	286	11.1 ± 1.5
	18.5-22.9 kg/m2	337	65.1 ± 5.0	382	53.9 ± 4.3	400	49.2 ± 3.7	375	47.9 ± 3.8	1494	56.0 ± 2.4
	23.0-24.9 kg/m2	61	11.9 ± 3.8	150	21.9 ± 3.6	164	20.1 ± 3.1	173	21.6 ± 3.1	548	17.9 ± 1.9
	25.0-29.9 kg/m2	33	5.8 ± 2.1	91	13.2 ± 3.1	160	21.1 ± 3.0	168	22.4 ± 3.4	452	13.6 ± 1.4
	30+ kg/m2	7	1.3 ± 1.0	8	1.3 ± 1.0	17	2.2 ± 1.2	9	1.1 ± 0.7	41	1.5 ± 0.5
	Rural										
	<18.5 kg/m2	265	19.3 ± 4.1	205	12.4 ± 2.8	256	14.8 ± 3.5	318	18.2 ± 3.1	1044	16.0 ± 1.9
	18.5-22.9 kg/m2	789	64.8 ± 3.6	773	64.7 ± 3.5	763	54.6 ± 3.6	662	48.6 ± 4.0	2987	60.2 ± 1.9
	23.0-24.9 kg/m2	100	9.1 ± 2.6	161	14.9 ± 3.1	189	17.3 ± 3.3	184	17.8 ± 2.9	634	13.9 ± 1.5
	25.0-29.9 kg/m2	46	5.7 ± 2.7	79	7.5 ± 2.2	133	12.8 ± 3.0	125	13.8 ± 2.8	383	9.0 ± 1.4
	30+ kg/m2	4	1.0 ± 1.1	5	0.5 ± 0.5	5	0.5 ± 0.6	12	1.6 ± 1.0	26	0.8 ± 0.4

Total										
<18.5 kg/m2	365	18.3 ± 3.0	273	11.6 ± 2.1	315	12.5 ± 2.5	377	14.8 ± 2.3	1330	14.5 ± 1.4
18.5-22.9 kg/m2	1126	64.9 ± 3.0	1155	61.4 ± 2.7	1163	52.9 ± 2.7	1037	48.4 ± 3.0	4481	58.9 ± 1.5
23.0-24.9 kg/m2	161	10.0 ± 2.1	311	17.0 ± 2.4	353	18.2 ± 2.5	357	18.9 ± 2.2	1182	15.1 ± 1.2
25.0-29.9 kg/m2	79	5.7 ± 2.0	170	9.2 ± 1.8	293	15.3 ± 2.3	293	16.4 ± 2.2	835	10.4 ± 1.0
30+ kg/m2	11	1.1 ± 0.8	13	0.8 ± 0.5	22	1.0 ± 0.5	21	1.5 ± 0.7	67	1.0 ± 0.3

Table 6. Blood pressure levels of participants in the Vietnam STEPS survey

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Normotensive	396	91.6 ± 3.4	503	85.1 ± 3.1	446	70.6 ± 4.2	415	58.3 ± 3.8	1760	81.1 ± 1.9
	Hypertensive*	32	8.4 ± 3.4	94	14.9 ± 3.1	185	29.4 ± 4.2	299	41.7 ± 3.8	610	18.9 ± 1.9
	Rural										
	Normotensive	891	90.5 ± 3.4	853	82.2 ± 2.8	822	72.2 ± 3.9	700	59.3 ± 4.9	3266	80.4 ± 1.8
	Hypertensive*	104	9.5 ± 3.4	216	17.8 ± 2.8	338	27.8 ± 3.9	510	40.7 ± 4.9	1168	19.6 ± 1.8
	Total										
	Normotensive	1287	90.8 ± 2.6	1356	83.0 ± 2.1	1268	71.7 ± 3.0	1115	59.0 ± 3.6	5026	80.6 ± 1.4
	Hypertensive*	136	9.2 ± 2.6	310	17.0 ± 2.1	523	28.3 ± 3.0	809	41.0 ± 3.6	1778	19.4 ± 1.4
Women	*Urban*										
	Normotensive	525	97.7 ± 1.3	632	90.5 ± 2.4	640	79.0 ± 3.4	503	64.0 ± 3.5	2300	87.1 ± 1.2
	Hypertensive*	14	2.3 ± 1.3	68	9.5 ± 2.4	160	21.0 ± 3.4	281	36.0 ± 3.5	523	12.9 ± 1.2
	Rural										
	Normotensive	1163	96.9 ± 1.3	1127	92.2 ± 2.6	1084	83.7 ± 2.6	909	72.1 ± 3.7	4283	89.2 ± 1.2
	Hypertensive*	43	3.1 ± 1.3	98	7.8 ± 2.6	262	16.3 ± 2.6	393	27.9 ± 3.7	796	10.8 ± 1.2
	Total										
	Normotensive	1688	97.1 ± 1.0	1759	91.7 ± 1.9	1724	82.3 ± 2.1	1412	69.7 ± 2.8	6583	88.5 ± 0.9
	Hypertensive*	57	2.9 ± 1.0	166	8.3 ± 1.9	422	17.7 ± 2.1	674	30.3 ± 2.8	1319	11.5 ± 0.9

* Systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or using hypertensive medications.

Table 7. Fasting blood glucose levels of participants in the Vietnam STEPS survey

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<5.6 mmol/L	383	96.6 ± 2.1	543	95.4 ± 2.0	552	92.7 ± 2.5	618	89.5 ± 2.6	2096	94.6 ± 1.2
	5.6-6.1 mmol/L	11	1.5 ± 1.3	14	2.7 ± 1.6	17	2.9 ± 1.6	34	4.8 ± 1.6	76	2.6 ± 0.8
	6.1+ mmol/L	5	1.8 ± 1.6	11	1.9 ± 1.4	28	4.4 ± 1.8	43	5.7 ± 2.1	87	2.9 ± 0.9
	Rural										
	<5.6 mmol/L	904	96.5 ± 2.4	974	97.2 ± 1.4	1041	95.4 ± 1.8	1075	93.1 ± 2.8	3994	96.1 ± 1.1
	5.6-6.1 mmol/L	28	1.6 ± 1.1	23	1.4 ± 1.1	32	1.8 ± 1.2	46	3.1 ± 1.5	129	1.8 ± 0.6
	6.1+ mmol/L	17	1.9 ± 2.2	19	1.4 ± 1.1	41	2.8 ± 1.5	43	3.8 ± 1.9	120	2.2 ± 0.9
	Total										
	<5.6 mmol/L	1287	96.5 ± 1.8	1517	96.6 ± 1.2	1593	94.5 ± 1.5	1693	92 ± 2.1	6090	95.6 ± 0.8
	5.6-6.1 mmol/L	39	1.6 ± 0.8	37	1.8 ± 0.9	49	2.2 ± 1.0	80	3.6 ± 1.2	205	2 ± 0.5
	6.1+ mmol/L	22	1.9 ± 1.6	30	1.6 ± 0.8	69	3.3 ± 1.2	86	4.4 ± 1.5	207	2.4 ± 0.7
Women	*Urban*										
	<5.6 mmol/L	499	98.2 ± 1.4	646	97.4 ± 1.4	714	95.5 ± 1.4	674	89.2 ± 2.4	2533	96.2 ± 0.8
	5.6-6.1 mmol/L	3	0.4 ± 0.6	13	1.3 ± 1.0	16	1.9 ± 1.0	36	3.9 ± 1.5	68	1.4 ± 0.5
	6.1+ mmol/L	5	1.4 ± 1.3	12	1.3 ± 0.9	23	2.7 ± 1.1	51	6.9 ± 1.9	91	2.3 ± 0.6
	Rural										
	<5.6 mmol/L	1140	99.0 ± 0.9	1146	97.9 ± 1.2	1227	95.8 ± 1.3	1150	91.9 ± 2.4	4663	97 ± 0.6
	5.6-6.1 mmol/L	11	0.7 ± 0.7	22	0.9 ± 0.6	27	1.1 ± 0.7	41	2.5 ± 1.5	101	1.1 ± 0.4
	6.1+ mmol/L	10	0.3 ± 0.4	15	1.1 ± 1.1	39	3.1 ± 1.2	53	5.6 ± 1.8	117	1.9 ± 0.5
	Total										
	<5.6 mmol/L	1639	98.7 ± 0.7	1792	97.8 ± 0.9	1941	95.7 ± 1.0	1824	91.1 ± 1.8	7196	96.8 ± 0.5
	5.6-6.1 mmol/L	14	0.6 ± 0.5	35	1.0 ± 0.5	43	1.3 ± 0.6	77	2.9 ± 1.1	169	1.2 ± 0.3
	6.1+ mmol/L	15	0.7 ± 0.5	27	1.2 ± 0.8	62	2.9 ± 0.9	104	6 ± 1.4	208	2 ± 0.4

Table 8. Fasting blood cholesterol levels of participants in the Vietnam STEPS survey

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5.0 mmol/L	312	74.8 ± 5.2	373	61.5 ± 5.8	360	57.1 ± 4.6	389	55.0 ± 4.6	1434	64.5 ± 2.8
	5.0-6.1 mmol/L	76	22.6 ± 5.2	159	30.7 ± 4.8	187	33.2 ± 3.7	238	35.0 ± 4.4	660	28.9 ± 2.5
	6.2+ mmol/L	9	2.5 ± 1.8	34	7.8 ± 2.7	50	9.8 ± 2.9	65	9.9 ± 2.6	158	6.6 ± 1.3
	Rural										
	< 5.0 mmol/L	802	80.6 ± 5.3	782	73.5 ± 3.7	829	70.5 ± 4.5	866	71.1 ± 3.8	3279	75.1 ± 2.5
	5.0-6.1 mmol/L	127	16.2 ± 4.1	204	23.0 ± 3.3	249	23.7 ± 4.0	254	23.8 ± 3.6	834	20.8 ± 2.0
	6.2+ mmol/L	20	3.2 ± 2.6	32	3.5 ± 1.5	37	5.8 ± 2.3	40	5.1 ± 2.0	129	4.1 ± 1.2
	Total										
	< 5.0 mmol/L	1114	78.8 ± 4.0	1155	69.9 ± 3.1	1189	66.2 ± 3.4	1255	66.4 ± 3.0	4713	71.9 ± 1.9
	5.0-6.1 mmol/L	203	18.2 ± 3.3	363	25.3 ± 2.7	436	26.7 ± 3.0	492	27.1 ± 2.9	1494	23.3 ± 1.6
	6.2+ mmol/L	29	3.0 ± 1.9	66	4.8 ± 1.3	87	7.1 ± 1.8	105	6.5 ± 1.6	287	4.9 ± 0.9
Women	*Urban*										
	< 5.0 mmol/L	404	78.1 ± 4.7	448	62.2 ± 5.5	384	49.3 ± 4.4	283	35.1 ± 4.3	1519	61.4 ± 2.6
	5.0-6.1 mmol/L	90	19.3 ± 4.8	193	33.1 ± 5.0	267	36.7 ± 3.8	332	45.1 ± 4.8	882	30.5 ± 2.5
	6.2+ mmol/L	10	2.6 ± 1.5	28	4.7 ± 2.0	100	14.1 ± 2.5	142	19.8 ± 3.2	280	8.0 ± 1.1
	Rural										
	< 5.0 mmol/L	978	77.7 ± 5.9	944	75.6 ± 4.1	830	60.6 ± 3.3	670	46.8 ± 5.1	3422	69.2 ± 2.6
	5.0-6.1 mmol/L	168	21.3 ± 5.8	208	21.0 ± 4.6	376	31.2 ± 3.1	469	42.7 ± 4.5	1221	26.2 ± 2.6
	6.2+ mmol/L	16	1.0 ± 1.0	28	3.4 ± 1.4	87	8.2 ± 2.1	106	10.5 ± 3.2	237	4.6 ± 0.8
	Total										
	< 5.0 mmol/L	1382	77.8 ± 4.3	1392	71.6 ± 3.3	1214	57.1 ± 2.7	953	43.2 ± 3.8	4941	66.8 ± 1.9
	5.0-6.1 mmol/L	258	20.7 ± 4.2	401	24.7 ± 3.6	643	32.9 ± 2.4	801	43.5 ± 3.4	2103	27.6 ± 1.9
	6.2+ mmol/L	26	1.5 ± 0.8	56	3.8 ± 1.1	187	10.0 ± 1.6	248	13.3 ± 2.4	517	5.7 ± 0.7

Table 1.1. Smoking status of participants in Thai Nguyen

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Never	13	32.5 ± 21.1	8	24.8 ± 4.5	16	36.3 ± 18.4	15	32.3 ± 11.8	52	31.5 ± 8.8
	Ex-smoker	2	5.8 ± 6.9	7	21.2 ± 11.9	12	27.7 ± 12.4	11	24.0 ± 4.2	32	18.5 ± 5.2
	Current non-daily	3	6.8 ± 8.5	2	5.8 ± 6.9	1	1.9 ± 3.8	3	6.5 ± 8.4	9	5.1 ± 3.6
	Current daily	19	54.8 ± 25.5	16	48.2 ± 11.5	15	34.1 ± 5.0	17	37.2 ± 11.9	67	44.9 ± 9.0
	Rural										
	Never	89	38.9 ± 8.7	40	13.8 ± 5.2	46	26.1 ± 6.5	50	19.2 ± 6.1	225	26.4 ± 3.9
	Ex-smoker	21	6.3 ± 3.2	40	24.2 ± 9.6	34	16.7 ± 6.2	65	30.1 ± 9.2	160	16.4 ± 3.5
	Current non-daily	15	7.1 ± 5.3	6	2.6 ± 2.7	4	1.7 ± 2.6	5	4.3 ± 5.5	30	4.2 ± 2.3
	Current daily	98	47.7 ± 11.1	101	59.4 ± 11.8	108	55.5 ± 9.4	80	46.4 ± 8.1	387	52.9 ± 5.8
	Total										
	Never	102	37.6 ± 8.1	48	16.0 ± 4.3	62	28.6 ± 6.7	65	22.9 ± 5.5	277	27.6 ± 3.6
	Ex-smoker	23	6.2 ± 2.9	47	23.6 ± 8.0	46	19.5 ± 5.6	76	28.3 ± 6.7	192	16.9 ± 3.0
	Current non-daily	18	7.0 ± 4.6	8	3.3 ± 2.6	5	1.8 ± 2.1	8	4.9 ± 4.6	39	4.4 ± 1.9
	Current daily	117	49.2 ± 10.2	117	57.2 ± 9.7	123	50.1 ± 7.1	97	43.8 ± 6.7	454	51.1 ± 5.0
Women	*Urban*										
	Never	42	97.5 ± 4.9	51	97.7 ± 4.5	50	100.0 ± 0.0	55	100.0 ± 0.0	198	98.6 ± 1.9
	Ex-smoker	0	0.0 ± 0.0	1	2.3 ± 4.5	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.6 ± 1.2
	Current non-daily	1	2.5 ± 4.9	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.8 ± 1.5
	Rural										
	Never	248	99.1 ± 1.8	206	98.3 ± 2.2	207	98.9 ± 1.8	217	97.9 ± 2.5	878	98.6 ± 1.0
	Ex-smoker	0	0.0 ± 0.0	0	0.0 ± 0.0	2	0.2 ± 0.3	1	1.0 ± 1.9	3	0.2 ± 0.2
	Current non-daily	1	0.9 ± 1.8	2	1.7 ± 2.2	1	0.9 ± 1.8	2	1.1 ± 2.0	6	1.2 ± 1.0
	Total										
	Never	290	98.7 ± 1.8	257	98.1 ± 1.9	257	99.1 ± 1.4	272	98.5 ± 1.8	1076	98.6 ± 0.9
	Ex-smoker	0	0.0 ± 0.0	1	0.5 ± 0.9	2	0.2 ± 0.2	1	0.7 ± 1.4	4	0.3 ± 0.3
	Current non-daily	1	0.5 ± 1.0	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.2 ± 0.4
	Current daily	1	0.7 ± 1.4	2	1.4 ± 1.7	1	0.7 ± 1.4	2	0.8 ± 1.4	6	0.9 ± 0.8

Table 1.2. Alcohol consumption of participants in Thai Nguyen

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Ever consume alc.	30	78.5 ± 17.4	27	83.8 ± 11.6	39	88.5 ± 7.9	39	85.1 ± 6.8	135	83.6 ± 6.8
	Consumed last 12ms	29	76.2 ± 14.0	27	83.8 ± 11.6	39	88.5 ± 7.9	37	80.6 ± 2.4	132	82.2 ± 5.9
	Hazardous drinking*	8	20.3 ± 10.7	4	9.1 ± 12.6	6	15.0 ± 13.0	2	4.5 ± 8.9	20	13.7 ± 6.1
	Harmful drinking†	7	19.4 ± 6.6	4	13.1 ± 14.8	6	13.4 ± 14.0	1	2.3 ± 4.5	18	13.7 ± 5.9
	Rural										
	Ever consume alc.	191	86.2 ± 3.9	163	89.9 ± 4.1	162	82.5 ± 5.3	161	83.6 ± 4.8	677	86.2 ± 2.3
	Consumed last 12ms	189	85.9 ± 3.9	161	87.1 ± 5.1	159	82.0 ± 5.4	153	81.3 ± 4.5	662	84.9 ± 2.5
	Hazardous drinking*	25	7.1 ± 2.1	24	5.3 ± 3.2	31	12.6 ± 3.0	22	11.3 ± 5.0	102	8.3 ± 1.5
	Harmful drinking†	42	21.4 ± 7.4	23	13.3 ± 5.7	26	10.6 ± 4.2	17	7.9 ± 4.7	108	15.1 ± 3.4
	Total										
	Ever consume alc.	221	84.6 ± 4.7	190	88.7 ± 4.0	201	84.0 ± 4.4	200	84.0 ± 3.9	812	85.6 ± 2.4
	Consumed last 12ms	218	84.0 ± 4.2	188	86.4 ± 4.7	198	83.6 ± 4.5	190	81.1 ± 3.3	794	84.3 ± 2.3
	Hazardous drinking*	33	9.8 ± 2.7	28	6.0 ± 3.6	37	13.2 ± 4.0	24	9.4 ± 4.4	122	9.5 ± 1.8
	Harmful drinking†	49	21.0 ± 6.1	27	13.2 ± 5.5	32	11.3 ± 4.7	18	6.3 ± 3.6	126	14.8 ± 2.9
Women	*Urban*										
	Ever consume alc.	8	18.9 ± 16.1	6	10.5 ± 7.7	7	14.5 ± 9.1	8	14.0 ± 9.8	29	14.8 ± 6.2
	Consumed last 12ms	7	17.6 ± 16.7	6	10.5 ± 7.7	6	12.3 ± 5.3	7	12.1 ± 8.1	26	13.5 ± 5.9
	Hazardous drinking*	0	0.0 ± 0.0	2	3.4 ± 3.9	1	1.9 ± 3.8	0	0.0 ± 0.0	3	1.4 ± 1.4
	Harmful drinking†	1	2.5 ± 4.9	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.8 ± 1.5
	Rural										
	Ever consume alc.	28	16.6 ± 9.7	30	15.9 ± 8.7	32	21.4 ± 10.2	36	21.8 ± 7.0	126	18.2 ± 5.0
	Consumed last 12ms	25	15.5 ± 8.5	26	13.5 ± 10.3	30	19.4 ± 8.6	35	20.7 ± 6.6	116	16.5 ± 4.7
	Hazardous drinking*	5	2.2 ± 3.7	10	6.5 ± 5.5	10	7.4 ± 5.4	12	7.0 ± 6.4	37	5.3 ± 2.5
	Harmful drinking†	3	1.9 ± 2.2	1	0.2 ± 0.3	0	0.0 ± 0.0	1	0.1 ± 0.2	5	0.7 ± 0.8
	Total										
	Ever consume alc.	36	17.1 ± 8.4	36	14.8 ± 7.1	39	19.7 ± 8.0	44	19.7 ± 5.8	155	17.4 ± 4.1
	Consumed last 12ms	32	16.0 ± 7.5	32	12.9 ± 8.3	36	17.7 ± 6.6	42	18.4 ± 5.3	142	15.8 ± 3.9
	Hazardous drinking*	5	1.7 ± 2.9	12	5.9 ± 4.4	11	6.1 ± 4.2	12	5.1 ± 4.6	40	4.4 ± 2.0
	Harmful drinking†	4	2.1 ± 2.1	1	0.1 ± 0.3	0	0.0 ± 0.0	1	0.1 ± 0.2	6	0.7 ± 0.7

* Hazardous drinking: ≥4 standard drinks (men), ≥2 standard drinks (women); † Harmful drinking: ≥6 standard drinks (men), ≥4 standard drinks (women).

Table 1.3. Servings of fruit and vegetable in Thai Nguyen

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5 servings/day	20	55.8 ± 13.7	22	72.4 ± 21.8	28	63.1 ± 9.6	29	63.5 ± 12.8	99	63.2 ± 7.9
	≥ 5 servings/day	17	44.2 ± 13.7	11	27.6 ± 21.8	16	36.9 ± 9.6	17	36.5 ± 12.8	61	36.8 ± 7.9
	Rural										
	< 5 servings/day	160	71.2 ± 7.4	135	72.3 ± 16.4	143	83.1 ± 5.8	147	74.1 ± 16.8	585	74.6 ± 6.0
	≥ 5 servings/day	62	28.8 ± 7.4	52	27.7 ± 16.4	49	16.9 ± 5.8	54	25.9 ± 16.8	217	25.4 ± 6.0
	Total										
	< 5 servings/day	180	68.1 ± 6.5	157	72.3 ± 13.9	171	78.1 ± 5.0	176	71.1 ± 12.6	684	72.1 ± 5.0
	≥ 5 servings/day	79	31.9 ± 6.5	63	27.7 ± 13.9	65	21.9 ± 5.0	71	28.9 ± 12.6	278	27.9 ± 5.0
Women	*Urban*										
	< 5 servings/day	32	71.1 ± 15.8	35	65.5 ± 16.9	32	65.5 ± 26.8	42	77.1 ± 10.5	141	69.1 ± 10.0
	≥ 5 servings/day	11	28.9 ± 15.8	16	34.5 ± 16.9	18	34.5 ± 26.8	13	22.9 ± 10.5	58	30.9 ± 10.0
	Rural										
	< 5 servings/day	194	79.0 ± 8.9	165	82.4 ± 7.2	161	82.8 ± 5.8	181	86.4 ± 6.7	701	81.8 ± 4.1
	≥ 5 servings/day	55	21.0 ± 8.9	43	17.6 ± 7.2	49	17.2 ± 5.8	39	13.6 ± 6.7	186	18.2 ± 4.1
	Total										
	< 5 servings/day	226	77.3 ± 7.8	200	78.9 ± 6.7	193	78.6 ± 7.9	223	83.9 ± 5.6	842	78.9 ± 3.9
	≥ 5 servings/day	66	22.7 ± 7.8	59	21.1 ± 6.7	67	21.4 ± 7.9	52	16.1 ± 5.6	244	21.1 ± 3.9

Table 1.4. Physical activity levels of participants in Thai Nguyen

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Low*	2	5.4 ± 6.3	4	17.0 ± 21.9	5	11.5 ± 3.9	1	2.3 ± 4.5	12	9.7 ± 6.2
	Moderate†	6	16.2 ± 13.7	3	12.1 ± 10.2	8	16.6 ± 11.2	8	17.8 ± 12.9	25	15.5 ± 6.3
	High‡	29	78.4 ± 7.5	26	70.9 ± 30.2	31	71.9 ± 11.8	37	79.9 ± 11.7	123	74.8 ± 9.0
	Rural										
	Low*	4	1.9 ± 3.3	5	3.6 ± 4.6	7	4.7 ± 3.6	10	6.2 ± 8.1	26	3.5 ± 2.2
	Moderate†	6	1.4 ± 1.7	3	3.5 ± 4.4	12	8.4 ± 4.0	20	13.3 ± 3.4	41	4.9 ± 1.8
	High‡	213	96.7 ± 4.9	179	92.8 ± 6.4	173	86.9 ± 6.9	171	80.5 ± 9.9	736	91.6 ± 3.2
	Total										
	Low*	6	2.6 ± 2.9	9	6.3 ± 5.7	12	6.4 ± 2.9	11	5.1 ± 5.9	38	4.9 ± 2.2
	Moderate†	12	4.4 ± 3.1	6	5.2 ± 4.1	20	10.5 ± 4.1	28	14.6 ± 4.4	66	7.2 ± 2.0
	High‡	242	93.0 ± 4.2	205	88.4 ± 7.9	204	83.1 ± 6.0	208	80.3 ± 7.9	859	87.9 ± 3.2
Women	*Urban*										
	Low*	7	18.9 ± 16.1	6	12.8 ± 15.8	4	7.6 ± 10.7	9	17.3 ± 11.2	26	14.0 ± 7.4
	Moderate†	11	27.8 ± 21.6	10	20.1 ± 6.5	8	15.3 ± 13.4	14	25.0 ± 7.0	43	22.0 ± 8.0
	High‡	25	53.3 ± 35.5	36	67.1 ± 16.1	38	77.1 ± 15.5	32	57.7 ± 6.7	131	64.0 ± 12.7
	Rural										
	Low*	8	3.2 ± 2.4	4	3.1 ± 2.7	8	4.4 ± 2.5	12	4.9 ± 4.0	32	3.7 ± 1.4
	Moderate†	11	5.9 ± 5.3	15	8.2 ± 6.8	17	7.4 ± 7.5	25	11.5 ± 6.0	68	7.6 ± 3.3
	High‡	230	90.9 ± 6.9	189	88.7 ± 6.3	185	88.2 ± 9.0	183	83.6 ± 6.5	787	88.7 ± 3.8
	Total										
	Low*	15	6.5 ± 3.9	10	5.1 ± 3.9	12	5.2 ± 3.2	21	8.3 ± 4.2	58	6.0 ± 2.0
	Moderate†	22	10.5 ± 6.2	25	10.7 ± 5.5	25	9.3 ± 6.5	39	15.2 ± 4.8	111	10.9 ± 3.1
	High‡	255	82.9 ± 9.3	225	84.2 ± 6.0	223	85.5 ± 7.8	215	76.5 ± 5.1	918	83.1 ± 4.1

* Low: < 600 MET-minutes per week; † Moderate: 600-2999 MET-minutes per week; ‡ High: 3000+ MET-minutes per week

Table 1.5. Body mass index of participants in Thai Nguyen

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<18.5 kg/m2	5	16.5 ± 19.0	3	8.1 ± 9.3	3	5.9 ± 7.3	3	6.1 ± 7.4	14	9.9 ± 7.0
	18.5-22.9 kg/m2	23	58.7 ± 23.8	18	54.1 ± 14.8	27	60.8 ± 10.5	25	54.4 ± 25.2	93	57.5 ± 9.7
	23.0-24.9 kg/m2	6	15.8 ± 7.8	4	10.4 ± 7.7	6	15.5 ± 15.7	7	15.6 ± 13.6	23	14.3 ± 5.8
	25.0-29.9 kg/m2	2	5.4 ± 6.3	7	23.9 ± 20.4	8	17.8 ± 5.2	11	24.0 ± 8.4	28	16.2 ± 6.0
	30+ kg/m2	1	3.6 ± 7.0	1	3.6 ± 7.0	0	0.0 ± 0.0	0	0.0 ± 0.0	2	2.1 ± 2.9
	Rural										
	<18.5 kg/m2	51	21.4 ± 4.4	37	27.8 ± 9.7	31	13.2 ± 5.3	61	34.9 ± 9.6	180	22.7 ± 3.7
	18.5-22.9 kg/m2	145	64.8 ± 10.7	125	63.3 ± 7.1	126	64.0 ± 14.3	114	53.2 ± 9.8	510	63.0 ± 5.7
	23.0-24.9 kg/m2	21	11.3 ± 10.9	17	4.2 ± 2.8	27	16.0 ± 9.5	13	7.9 ± 6.2	78	10.0 ± 4.7
	25.0-29.9 kg/m2	5	1.5 ± 2.0	7	4.5 ± 3.6	8	6.8 ± 4.7	13	4.0 ± 3.4	33	3.9 ± 1.7
	30+ kg/m2	1	1.1 ± 2.1	1	0.2 ± 0.3	0	0.0 ± 0.0	0	0.0 ± 0.0	2	0.4 ± 0.8
	Total										
	<18.5 kg/m2	56	20.4 ± 5.2	40	23.8 ± 8.0	34	11.4 ± 4.4	64	26.8 ± 7.2	194	19.8 ± 3.2
	18.5-22.9 kg/m2	168	63.5 ± 9.8	143	61.5 ± 6.4	153	63.2 ± 11.0	139	53.5 ± 10.0	603	61.8 ± 4.9
	23.0-24.9 kg/m2	27	12.2 ± 8.8	21	5.5 ± 2.7	33	15.9 ± 8.1	20	10.1 ± 5.8	101	10.9 ± 3.9
	25.0-29.9 kg/m2	7	2.3 ± 2.0	14	8.4 ± 5.0	16	9.6 ± 3.7	24	9.6 ± 3.4	61	6.6 ± 1.9
	30+ kg/m2	2	1.6 ± 2.2	2	0.8 ± 1.4	0	0.0 ± 0.0	0	0.0 ± 0.0	4	0.8 ± 0.9
Women	*Urban*										
	<18.5 kg/m2	9	14.8 ± 17.7	5	8.2 ± 10.9	4	8.4 ± 7.3	7	12.4 ± 11.8	25	10.9 ± 6.8
	18.5-22.9 kg/m2	28	73.5 ± 21.7	26	49.8 ± 4.5	24	47.6 ± 21.2	33	59.7 ± 10.1	111	58.2 ± 9.1
	23.0-24.9 kg/m2	3	6.6 ± 5.0	16	31.4 ± 7.0	11	21.8 ± 16.0	8	15.2 ± 11.2	38	18.5 ± 5.2
	25.0-29.9 kg/m2	3	5.1 ± 5.8	4	8.4 ± 6.2	10	20.3 ± 8.6	7	12.8 ± 7.1	24	11.3 ± 3.5
	30+ kg/m2	0	0.0 ± 0.0	1	2.3 ± 4.5	1	1.9 ± 3.8	0	0.0 ± 0.0	2	1.1 ± 1.5
	Rural										
	<18.5 kg/m2	66	24.3 ± 9.0	45	19.2 ± 4.7	52	22.1 ± 13.2	62	26.2 ± 9.6	225	22.5 ± 4.8
	18.5-22.9 kg/m2	166	68.3 ± 7.5	143	69.7 ± 7.3	120	57.6 ± 10.2	125	56.8 ± 12.7	554	64.7 ± 4.5
	23.0-24.9 kg/m2	13	5.5 ± 4.4	12	6.6 ± 4.7	23	12.8 ± 5.3	21	12.0 ± 6.5	69	8.4 ± 2.5
	25.0-29.9 kg/m2	4	1.9 ± 3.4	8	4.4 ± 3.8	15	7.4 ± 4.6	12	5.0 ± 4.3	39	4.4 ± 2.0
	Total										
	<18.5 kg/m2	75	22.2 ± 8.0	50	16.9 ± 4.3	56	18.7 ± 10.1	69	22.4 ± 7.7	250	19.9 ± 4.0

18.5-22.9 kg/m2	194	69.4 ± 7.5	169	65.5 ± 5.9	144	55.2 ± 9.3	158	57.6 ± 9.7	665	63.2 ± 4.0
23.0-24.9 kg/m2	16	5.7 ± 3.6	28	11.8 ± 4.0	34	15.0 ± 5.6	29	12.9 ± 5.6	107	10.7 ± 2.3
25.0-29.9 kg/m2	7	2.6 ± 3.0	12	5.3 ± 3.3	25	10.6 ± 4.0	19	7.1 ± 3.6	63	6.0 ± 1.8
30+ kg/m2	0	0.0 ± 0.0	1	0.5 ± 0.9	1	0.5 ± 0.9	0	0.0 ± 0.0	2	0.3 ± 0.4

Table 1.6. Blood pressure levels of participants in Thai Nguyen

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Normotensive	33	88.4 ± 17.4	30	89.2 ± 12.5	23	50.1 ± 23.9	21	46.3 ± 11.0	107	72.0 ± 9.5
	Hypertensive*	4	11.6 ± 17.4	3	10.8 ± 12.5	21	49.9 ± 23.9	25	53.7 ± 11.0	53	28.0 ± 9.5
	Rural										
	Normotensive	209	92.0 ± 6.1	154	85.4 ± 4.2	135	72.3 ± 7.4	114	57.5 ± 10.9	612	81.9 ± 3.3
	Hypertensive*	14	8.0 ± 6.1	33	14.6 ± 4.2	57	27.7 ± 7.4	87	42.5 ± 10.9	191	18.1 ± 3.3
	Total										
	Normotensive	242	91.3 ± 6.0	184	86.2 ± 4.2	158	66.7 ± 8.2	135	54.4 ± 8.5	719	79.7 ± 3.3
	Hypertensive*	18	8.7 ± 6.0	36	13.8 ± 4.2	78	33.3 ± 8.2	112	45.6 ± 8.5	244	20.3 ± 3.3
Women	*Urban*										
	Normotensive	40	94.9 ± 5.8	46	88.2 ± 10.5	39	78.0 ± 14.0	41	74.1 ± 8.6	166	85.4 ± 5.2
	Hypertensive*	3	5.1 ± 5.8	6	11.8 ± 10.5	11	22.0 ± 14.0	14	25.9 ± 8.6	34	14.6 ± 5.2
	Rural										
	Normotensive	243	97.8 ± 2.3	195	95.0 ± 5.3	177	86.7 ± 5.1	170	77.6 ± 15.3	785	91.8 ± 2.8
	Hypertensive*	6	2.2 ± 2.3	13	5.0 ± 5.3	33	13.3 ± 5.1	50	22.4 ± 15.3	102	8.2 ± 2.8
	Total										
	Normotensive	283	97.2 ± 2.2	241	93.5 ± 4.7	216	84.6 ± 5.2	211	76.6 ± 11.4	951	90.4 ± 2.5
	Hypertensive*	9	2.8 ± 2.2	19	6.5 ± 4.7	44	15.4 ± 5.2	64	23.4 ± 11.4	136	9.6 ± 2.5

* Systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or using hypertensive medications.

Table 1.7. Fasting blood glucose levels of participants in Thai Nguyen

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<5.6 mmol/L	34	92.3 ± 5.3	32	93.8 ± 12.2	40	91.1 ± 12.6	41	88.6 ± 8.5	147	91.8 ± 5.2
	5.6-6.1 mmol/L	3	7.7 ± 5.3	1	6.2 ± 12.2	2	4.5 ± 8.9	3	6.8 ± 8.5	9	6.3 ± 4.5
	6.1+ mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	2	4.4 ± 4.9	2	4.5 ± 5.1	4	1.9 ± 1.6
	Rural										
	<5.6 mmol/L	216	97.8 ± 3.2	182	97.4 ± 4.6	181	93.8 ± 6.9	193	92.9 ± 3.4	772	96.2 ± 2.5
	5.6-6.1 mmol/L	2	1.0 ± 1.6	2	1.3 ± 2.3	5	2.6 ± 2.9	5	4.5 ± 4.3	14	1.8 ± 1.2
	6.1+ mmol/L	4	1.2 ± 1.7	2	1.3 ± 2.3	5	3.6 ± 4.2	2	2.5 ± 3.1	13	1.9 ± 1.4
	Total										
	<5.6 mmol/L	250	96.7 ± 2.8	214	96.7 ± 4.4	221	93.1 ± 6.0	234	91.7 ± 3.4	919	95.3 ± 2.2
	5.6-6.1 mmol/L	5	2.3 ± 1.7	3	2.3 ± 3.1	7	3.1 ± 3.1	8	5.2 ± 3.9	23	2.8 ± 1.4
	6.1+ mmol/L	4	1.0 ± 1.3	2	1.0 ± 1.8	7	3.8 ± 3.4	4	3.1 ± 2.7	17	1.9 ± 1.1
Women	*Urban*										
	<5.6 mmol/L	42	98.7 ± 2.6	51	97.7 ± 4.5	48	96.3 ± 4.2	49	89.3 ± 9.5	190	96.3 ± 2.3
	5.6-6.1 mmol/L	1	1.3 ± 2.6	1	2.3 ± 4.5	1	1.8 ± 3.5	2	3.5 ± 4.0	5	2.0 ± 1.8
	6.1+ mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	1	1.9 ± 3.8	4	7.2 ± 6.2	5	1.6 ± 1.4
	Rural										
	<5.6 mmol/L	247	99.1 ± 1.8	205	98.8 ± 1.8	204	97.7 ± 2.4	210	92.7 ± 8.6	866	97.9 ± 1.4
	5.6-6.1 mmol/L	1	0.9 ± 1.8	3	1.2 ± 1.8	2	1.1 ± 1.8	6	5.8 ± 8.9	12	1.6 ± 1.4
	6.1+ mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	4	1.3 ± 1.9	3	1.5 ± 2.5	7	0.5 ± 0.6
	Total										
	<5.6 mmol/L	289	99.0 ± 1.5	256	98.6 ± 1.7	252	97.3 ± 2.1	259	91.8 ± 6.8	1056	97.5 ± 1.2
	5.6-6.1 mmol/L	2	1.0 ± 1.5	4	1.4 ± 1.7	3	1.2 ± 1.6	8	5.2 ± 6.6	17	1.7 ± 1.2
	6.1+ mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	5	1.4 ± 1.7	7	3.1 ± 2.5	12	0.7 ± 0.5

Table 1.8. Fasting blood cholesterol levels of participants in Thai Nguyen

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5.0 mmol/L	31	82.5 ± 18.1	24	69.0 ± 16.7	25	53.9 ± 21.7	33	71.9 ± 14.6	113	69.4 ± 9.7
	5.0-6.1 mmol/L	5	14.0 ± 12.0	8	28.7 ± 16.4	16	37.9 ± 16.0	11	24.3 ± 15.7	40	26.0 ± 7.6
	6.2+ mmol/L	1	3.6 ± 7.0	1	2.3 ± 4.5	3	8.2 ± 11.6	2	3.8 ± 7.5	7	4.6 ± 4.3
	Rural										
	< 5.0 mmol/L	207	92.2 ± 4.1	156	82.8 ± 4.9	159	80.8 ± 10.7	167	82.7 ± 10.3	689	85.7 ± 3.5
	5.0-6.1 mmol/L	14	7.0 ± 4.7	28	15.7 ± 6.5	30	18.8 ± 10.8	28	12.2 ± 6.1	100	12.9 ± 3.7
	6.2+ mmol/L	1	0.8 ± 1.6	3	1.5 ± 2.3	3	0.3 ± 0.5	5	5.0 ± 5.3	12	1.3 ± 1.0
	Total										
	< 5.0 mmol/L	238	90.2 ± 4.9	180	80.0 ± 5.2	184	74.0 ± 9.7	200	79.7 ± 8.4	802	82.1 ± 3.5
	5.0-6.1 mmol/L	19	8.4 ± 4.5	36	18.3 ± 6.2	46	23.7 ± 9.0	39	15.6 ± 6.2	140	15.8 ± 3.3
	6.2+ mmol/L	2	1.4 ± 1.9	4	1.6 ± 2.1	6	2.3 ± 2.9	7	4.7 ± 4.4	19	2.0 ± 1.2
Women	*Urban*										
	< 5.0 mmol/L	39	90.0 ± 11.3	40	75.8 ± 20.2	28	55.6 ± 11.1	27	48.2 ± 14.6	134	70.6 ± 7.4
	5.0-6.1 mmol/L	2	5.0 ± 9.8	10	19.6 ± 11.5	18	35.6 ± 7.6	20	37.6 ± 18.1	50	22.1 ± 5.5
	6.2+ mmol/L	1	5.0 ± 9.8	2	4.5 ± 8.9	4	8.7 ± 9.9	8	14.1 ± 8.3	15	7.3 ± 4.9
	Rural										
	< 5.0 mmol/L	231	95.6 ± 2.5	188	92.6 ± 5.0	172	84.5 ± 10.1	157	69.5 ± 15.1	748	88.9 ± 3.5
	5.0-6.1 mmol/L	18	4.4 ± 2.5	16	5.1 ± 3.7	35	15.2 ± 10.0	56	28.8 ± 13.8	125	10.2 ± 3.3
	6.2+ mmol/L	0	0.0 ± 0.0	3	2.3 ± 2.8	3	0.3 ± 0.3	7	1.7 ± 2.2	13	1.0 ± 0.9
	Total										
	< 5.0 mmol/L	270	94.4 ± 3.1	228	89.1 ± 5.8	200	77.4 ± 8.1	184	63.7 ± 11.6	882	84.7 ± 3.2
	5.0-6.1 mmol/L	20	4.6 ± 2.9	26	8.1 ± 3.8	53	20.2 ± 7.8	76	31.2 ± 11.2	175	12.9 ± 2.8
	6.2+ mmol/L	1	1.1 ± 2.1	5	2.8 ± 2.9	7	2.4 ± 2.4	15	5.1 ± 2.8	28	2.4 ± 1.3

Table 2.1. Smoking status of participants in Hoa Binh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Never	11	54.2 ± 8.2	18	49.7 ± 10.1	9	42.9 ± 18.0	9	25.0 ± 9.4	47	45.7 ± 6.7
	Ex-smoker	3	12.5 ± 14.1	6	14.4 ± 14.6	5	22.9 ± 5.6	10	27.8 ± 10.9	24	18.1 ± 6.2
	Current non-daily	1	8.3 ± 16.3	1	3.0 ± 5.9	0	0.0 ± 0.0	2	5.6 ± 5.4	4	4.0 ± 5.1
	Current daily	5	25.0 ± 0.0	12	32.8 ± 7.4	8	34.3 ± 14.1	15	41.7 ± 9.4	40	32.2 ± 4.9
	Rural										
	Never	67	36.2 ± 25.1	56	15.2 ± 11.9	66	26.9 ± 4.0	83	46.7 ± 18.2	272	28.5 ± 10.0
	Ex-smoker	18	8.6 ± 10.9	28	22.1 ± 11.8	32	14.9 ± 5.2	30	12.5 ± 6.0	108	14.6 ± 5.5
	Current non-daily	11	4.9 ± 6.4	3	6.3 ± 11.7	3	0.4 ± 0.4	2	0.3 ± 0.4	19	3.8 ± 4.3
	Current daily	89	50.3 ± 29.5	92	56.4 ± 11.9	109	57.7 ± 8.7	81	40.5 ± 24.0	371	53.0 ± 11.7
	Total										
	Never	78	38.0 ± 22.6	74	19.0 ± 10.7	75	29.3 ± 4.3	92	43.2 ± 15.3	319	30.5 ± 8.8
	Ex-smoker	21	9.0 ± 9.9	34	21.3 ± 10.6	37	16.1 ± 4.5	40	14.9 ± 5.4	132	15.0 ± 4.9
	Current non-daily	12	5.2 ± 6.0	4	6.0 ± 10.4	3	0.3 ± 0.4	4	1.2 ± 0.9	23	3.8 ± 3.8
	Current daily	94	47.8 ± 26.6	104	53.8 ± 10.6	117	54.3 ± 7.8	96	40.7 ± 20.2	411	50.6 ± 10.3
Women	*Urban*										
	Never	23	100.0 ± 0.0	38	100.0 ± 0.0	38	94.3 ± 6.3	39	95.5 ± 4.4	138	97.8 ± 1.9
	Ex-smoker	0	0.0 ± 0.0	0	0.0 ± 0.0	1	3.7 ± 7.3	1	2.4 ± 4.7	2	1.4 ± 2.2
	Current non-daily	0	0.0 ± 0.0	0	0.0 ± 0.0	1	2.0 ± 3.8	1	2.1 ± 4.1	2	0.8 ± 1.2
	Rural										
	Never	237	99.8 ± 0.3	191	81.8 ± 17.7	186	82.6 ± 26.3	147	83.4 ± 16.4	761	88.2 ± 8.7
	Ex-smoker	0	0.0 ± 0.0	4	6.9 ± 12.7	1	0.2 ± 0.3	17	5.2 ± 5.6	22	2.7 ± 3.9
	Current non-daily	0	0.0 ± 0.0	0	0.0 ± 0.0	2	0.3 ± 0.4	2	0.4 ± 0.7	4	0.1 ± 0.1
	Current daily	2	0.2 ± 0.3	9	11.4 ± 5.0	29	17.0 ± 26.3	40	11.0 ± 11.0	80	9.0 ± 6.8
	Total	.		.							
	Never	260	99.8 ± 0.3	229	83.9 ± 15.7	224	84.3 ± 22.6	186	85.3 ± 14.0	899	89.4 ± 7.6
	Ex-smoker	0	0.0 ± 0.0	4	6.1 ± 11.3	2	0.7 ± 1.1	18	4.8 ± 4.8	24	2.5 ± 3.4
	Current non-daily	0	0.0 ± 0.0	0	0.0 ± 0.0	2	0.2 ± 0.3	2	0.3 ± 0.6	4	0.1 ± 0.1
	Current daily	2	0.2 ± 0.3	9	10.1 ± 4.4	30	14.8 ± 22.6	41	9.6 ± 9.3	82	7.9 ± 6.0

Table 2.2. Alcohol consumption of participants in Hoa Binh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Ever consume alc.	14	70.8 ± 8.2	31	81.3 ± 30.8	15	65.2 ± 26.3	25	69.4 ± 23.7	85	71.9 ± 12.3
	Consumed last 12ms	14	70.8 ± 8.2	29	77.1 ± 28.6	15	65.2 ± 26.3	23	63.9 ± 28.8	81	70.0 ± 12.1
	Hazardous drinking*	4	20.8 ± 21.6	3	8.1 ± 10.5	2	6.7 ± 13.1	1	2.8 ± 5.4	10	10.7 ± 8.0
	Harmful drinking†	7	37.5 ± 24.5	5	12.6 ± 6.0	2	8.1 ± 8.3	2	5.6 ± 5.4	16	17.5 ± 7.7
	Rural										
	Ever consume alc.	166	83.1 ± 15.2	148	81.3 ± 4.1	176	67.1 ± 5.9	160	66.3 ± 7.6	650	77.2 ± 5.9
	Consumed last 12ms	161	79.5 ± 20.7	146	81.0 ± 4.2	173	66.7 ± 5.9	148	61.8 ± 13.0	628	75.3 ± 7.8
	Hazardous drinking*	46	22.1 ± 8.5	27	10.5 ± 11.8	32	11.7 ± 2.4	23	11.0 ± 4.8	128	15.0 ± 4.8
	Harmful drinking†	51	20.9 ± 13.8	53	16.7 ± 15.7	53	14.7 ± 2.2	40	17.1 ± 2.3	197	17.8 ± 7.0
	Total										
	Ever consume alc.	180	81.9 ± 13.8	179	81.3 ± 5.0	191	66.8 ± 6.3	185	66.8 ± 7.4	735	76.6 ± 5.4
	Consumed last 12ms	175	78.7 ± 18.7	175	80.6 ± 4.9	188	66.5 ± 6.3	171	62.2 ± 11.8	709	74.7 ± 7.0
	Hazardous drinking*	50	22.0 ± 8.0	30	10.2 ± 10.5	34	11.0 ± 2.8	24	9.7 ± 4.1	138	14.5 ± 4.3
	Harmful drinking†	58	22.5 ± 12.7	58	16.3 ± 14.0	55	13.8 ± 2.3	42	15.2 ± 2.1	213	17.7 ± 6.2
Women	*Urban*										
	Ever consume alc.	5	25.4 ± 25.5	9	19.6 ± 21.3	9	21.6 ± 15.9	15	39.7 ± 29.1	38	24.7 ± 11.4
	Consumed last 12ms	4	19.8 ± 24.4	9	19.6 ± 21.3	9	21.6 ± 15.9	12	31.9 ± 24.0	34	21.9 ± 11.0
	Hazardous drinking*	0	0.0 ± 0.0	1	2.4 ± 4.7	2	5.7 ± 6.3	2	5.4 ± 5.4	5	3.0 ± 2.3
	Harmful drinking†	0	0.0 ± 0.0	0	0.0 ± 0.0	1	2.0 ± 3.8	0	0.0 ± 0.0	1	0.6 ± 1.1
	Rural										
	Ever consume alc.	43	11.1 ± 11.8	28	15.8 ± 23.4	29	6.3 ± 4.7	41	10.9 ± 11.0	141	11.3 ± 8.3
	Consumed last 12ms	38	10.4 ± 11.8	28	15.8 ± 23.4	27	6.1 ± 4.7	39	10.7 ± 11.0	132	11.0 ± 8.3
	Hazardous drinking*	8	1.0 ± 0.6	7	1.0 ± 0.8	8	3.3 ± 4.5	18	5.3 ± 5.5	41	2.0 ± 1.3
	Harmful drinking†	4	0.5 ± 0.4	1	4.0 ± 7.8	8	1.1 ± 0.7	5	0.7 ± 0.6	18	1.7 ± 2.4
	Total										
	Ever consume alc.	48	12.8 ± 10.9	37	16.2 ± 20.9	38	8.5 ± 4.6	56	15.3 ± 10.3	179	13.0 ± 7.4
	Consumed last 12ms	42	11.5 ± 10.8	37	16.2 ± 20.9	36	8.3 ± 4.6	51	13.9 ± 10.0	166	12.4 ± 7.4
	Hazardous drinking*	8	0.9 ± 0.5	8	1.1 ± 0.9	10	3.7 ± 3.9	20	5.3 ± 4.7	46	2.2 ± 1.2
	Harmful drinking†	4	0.4 ± 0.4	1	3.5 ± 6.9	9	1.2 ± 0.8	5	0.6 ± 0.5	19	1.6 ± 2.1

* Hazardous drinking: ≥4 standard drinks (men), ≥2 standard drinks (women); † Harmful drinking: ≥6 standard drinks (men), ≥4 standard drinks (women).

Table 2.3. Servings of fruit and vegetable in Hoa Binh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5 servings/day	15	75.0 ± 14.1	27	73.7 ± 7.3	17	88.6 ± 11.7	27	76.8 ± 16.0	86	79.0 ± 6.1
	≥ 5 servings/day	5	25.0 ± 14.1	9	26.3 ± 7.3	2	11.4 ± 11.7	8	23.2 ± 16.0	24	21.0 ± 6.1
	Rural										
	< 5 servings/day	163	93.3 ± 6.7	146	79.4 ± 15.7	177	84.1 ± 23.4	163	90.3 ± 2.3	649	86.6 ± 7.8
	≥ 5 servings/day	18	6.7 ± 6.7	29	20.6 ± 15.7	30	15.9 ± 23.4	27	9.7 ± 2.3	104	13.4 ± 7.8
	Total										
	< 5 servings/day	178	91.6 ± 6.2	173	78.8 ± 14.0	194	84.8 ± 20.1	190	88.1 ± 3.2	735	85.7 ± 6.9
	≥ 5 servings/day	23	8.4 ± 6.2	38	21.2 ± 14.0	32	15.2 ± 20.1	35	11.9 ± 3.2	128	14.3 ± 6.9
Women	*Urban*										
	< 5 servings/day	14	63.3 ± 36.4	23	59.5 ± 26.0	25	63.7 ± 20.9	31	81.7 ± 3.4	93	64.9 ± 14.4
	≥ 5 servings/day	9	36.7 ± 36.4	14	40.5 ± 26.0	15	36.3 ± 20.9	7	18.3 ± 3.4	45	35.1 ± 14.4
	Rural										
	< 5 servings/day	172	78.1 ± 27.0	146	82.0 ± 19.2	148	66.0 ± 37.5	157	84.5 ± 16.3	623	77.0 ± 14.4
	≥ 5 servings/day	63	21.9 ± 27.0	59	18.0 ± 19.2	66	34.0 ± 37.5	47	15.5 ± 16.3	235	23.0 ± 14.4
	Total										
	< 5 servings/day	186	76.4 ± 24.3	169	79.4 ± 17.3	173	65.7 ± 32.3	188	84.1 ± 13.8	716	75.5 ± 12.7
	≥ 5 servings/day	72	23.6 ± 24.3	73	20.6 ± 17.3	81	34.3 ± 32.3	54	15.9 ± 13.8	280	24.5 ± 12.7

Table 2.4. Physical activity levels of participants in Hoa Binh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Low*	3	16.7 ± 8.2	12	30.6 ± 14.5	5	27.6 ± 27.1	9	25.0 ± 16.3	29	25.0 ± 9.7
	Moderate†	6	25.0 ± 28.3	6	18.4 ± 21.2	6	29.5 ± 11.4	14	38.9 ± 23.7	32	26.3 ± 11.1
	High‡	11	58.3 ± 21.6	19	50.9 ± 24.2	11	42.9 ± 36.7	13	36.1 ± 10.9	54	48.7 ± 14.5
	Rural										
	Low*	8	4.2 ± 5.4	4	0.7 ± 0.8	7	7.2 ± 12.7	22	18.3 ± 9.3	41	5.1 ± 3.7
	Moderate†	14	5.1 ± 5.5	10	5.4 ± 7.9	23	9.4 ± 12.9	24	9.5 ± 1.8	71	6.7 ± 4.4
	High‡	164	90.7 ± 10.9	165	93.9 ± 8.0	180	83.3 ± 25.5	151	72.3 ± 9.0	660	88.2 ± 7.7
	Total										
	Low*	11	5.4 ± 5.0	16	4.0 ± 1.7	12	10.2 ± 11.6	31	19.3 ± 8.2	70	7.5 ± 3.5
	Moderate†	20	7.1 ± 5.7	16	6.8 ± 7.4	29	12.4 ± 11.1	38	14.2 ± 4.1	103	9.0 ± 4.1
	High‡	175	87.5 ± 10.1	184	89.2 ± 7.6	191	77.5 ± 22.5	164	66.5 ± 7.8	714	83.5 ± 7.0
Women	*Urban*										
	Low*	11	51.4 ± 49.8	7	17.9 ± 10.5	10	26.9 ± 14.9	8	19.5 ± 2.0	36	30.8 ± 15.9
	Moderate†	1	4.8 ± 9.3	17	41.4 ± 17.7	12	28.7 ± 7.4	9	21.5 ± 3.9	39	24.0 ± 6.0
	High‡	11	43.8 ± 43.4	14	40.8 ± 21.3	18	44.4 ± 9.7	24	59.0 ± 4.6	67	45.2 ± 14.7
	Rural										
	Low*	15	10.1 ± 5.1	8	8.8 ± 15.6	11	4.7 ± 6.4	35	21.0 ± 21.2	69	9.6 ± 5.8
	Moderate†	11	4.1 ± 5.9	10	5.0 ± 6.5	13	13.3 ± 14.7	36	13.4 ± 5.6	70	7.7 ± 4.6
	High‡	213	85.8 ± 1.6	188	86.2 ± 9.3	194	82.0 ± 21.1	139	65.6 ± 26.2	734	82.7 ± 6.7
	Total										
	Low*	26	14.9 ± 7.3	15	9.8 ± 13.8	21	7.9 ± 5.9	43	20.8 ± 18.0	105	12.3 ± 5.4
	Moderate†	12	4.2 ± 5.3	27	9.2 ± 6.1	25	15.5 ± 12.7	45	14.6 ± 4.8	109	9.7 ± 4.1
	High‡	224	80.9 ± 5.2	202	81.0 ± 8.6	212	76.6 ± 18.1	163	64.6 ± 22.2	801	78.0 ± 6.1

* Low: < 600 MET-minutes per week; † Moderate: 600-2999 MET-minutes per week; ‡ High: 3000+ MET-minutes per week

Table 2.5. Body mass index of participants in Hoa Binh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<18.5 kg/m2	8	37.5 ± 24.5	1	3.0 ± 5.9	2	10.0 ± 11.3	5	13.9 ± 19.6	16	16.5 ± 8.4
	18.5-22.9 kg/m2	10	54.2 ± 29.4	23	63.0 ± 9.8	14	63.8 ± 7.5	13	36.1 ± 27.2	60	57.2 ± 9.9
	23.0-24.9 kg/m2	1	4.2 ± 8.2	8	21.4 ± 12.4	4	19.5 ± 10.5	13	36.1 ± 5.4	26	17.7 ± 5.3
	25.0-29.9 kg/m2	1	4.2 ± 8.2	5	12.6 ± 6.0	2	6.7 ± 13.1	5	13.9 ± 5.4	13	8.5 ± 4.9
	Rural										
	<18.5 kg/m2	24	10.5 ± 12.9	15	2.6 ± 1.2	32	9.0 ± 8.1	55	29.7 ± 9.1	126	9.5 ± 5.1
	18.5-22.9 kg/m2	138	74.3 ± 3.6	132	70.9 ± 19.5	133	73.6 ± 17.2	119	61.6 ± 8.7	522	71.9 ± 7.4
	23.0-24.9 kg/m2	16	11.1 ± 4.6	20	16.6 ± 4.1	28	14.7 ± 9.4	12	2.1 ± 1.0	76	12.8 ± 3.1
	25.0-29.9 kg/m2	8	4.1 ± 5.5	12	9.9 ± 15.6	16	2.6 ± 1.7	10	6.4 ± 0.9	46	5.7 ± 5.2
	30+ kg/m2	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.1 ± 0.2	1	0.2 ± 0.4	2	0.0 ± 0.1
	Total										
	<18.5 kg/m2	32	13.1 ± 11.8	16	2.6 ± 1.2	34	9.2 ± 7.1	60	27.2 ± 8.2	142	10.3 ± 4.6
	18.5-22.9 kg/m2	148	72.3 ± 4.3	155	70.1 ± 17.4	147	72.2 ± 14.7	132	57.5 ± 8.5	582	70.2 ± 6.7
	23.0-24.9 kg/m2	17	10.4 ± 4.2	28	17.2 ± 3.9	32	15.4 ± 8.2	25	7.6 ± 1.2	102	13.4 ± 2.8
	25.0-29.9 kg/m2	9	4.1 ± 5.1	17	10.2 ± 13.9	18	3.2 ± 2.4	15	7.6 ± 1.1	59	6.1 ± 4.6
	30+ kg/m2	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.1 ± 0.2	1	0.2 ± 0.3	2	0.0 ± 0.1
Women	*Urban*										
	<18.5 kg/m2	3	15.1 ± 16.2	2	4.8 ± 9.3	4	7.8 ± 15.4	6	14.3 ± 7.2	15	10.1 ± 7.1
	18.5-22.9 kg/m2	18	74.6 ± 25.5	23	61.6 ± 19.7	26	66.5 ± 21.9	19	45.8 ± 11.6	86	64.8 ± 11.4
	23.0-24.9 kg/m2	0	0.0 ± 0.0	9	23.2 ± 17.3	3	9.4 ± 13.0	7	17.4 ± 5.1	19	11.4 ± 6.1
	25.0-29.9 kg/m2	1	5.6 ± 10.9	4	10.4 ± 10.8	6	12.6 ± 13.4	9	22.5 ± 4.9	20	11.2 ± 5.9
	30+ kg/m2	1	4.8 ± 9.3	0	0.0 ± 0.0	1	3.7 ± 7.3	0	0.0 ± 0.0	2	2.5 ± 3.5
	Rural										
	<18.5 kg/m2	54	23.7 ± 2.2	37	8.8 ± 6.8	61	32.0 ± 4.0	81	39.0 ± 20.4	233	22.9 ± 3.3
	18.5-22.9 kg/m2	159	67.4 ± 2.3	142	70.6 ± 10.1	128	57.4 ± 16.4	104	46.8 ± 19.5	533	63.6 ± 5.6
	23.0-24.9 kg/m2	17	7.7 ± 1.1	20	16.7 ± 3.0	23	9.6 ± 12.8	14	4.7 ± 5.9	74	10.6 ± 3.4
	25.0-29.9 kg/m2	8	1.2 ± 0.9	5	3.9 ± 6.4	5	0.8 ± 1.0	9	6.7 ± 0.8	27	2.5 ± 2.0
	30+ kg/m2	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.2 ± 0.4	1	2.7 ± 5.4	2	0.4 ± 0.6
	Total										
	<18.5 kg/m2	57	22.7 ± 2.7	39	8.3 ± 6.1	65	28.5 ± 4.1	87	35.3 ± 17.3	248	21.3 ± 3.0

18.5-22.9 kg/m2	177	68.3 ± 3.6	165	69.6 ± 9.3	154	58.7 ± 14.4	123	46.7 ± 16.6	619	63.8 ± 5.1
23.0-24.9 kg/m2	17	6.8 ± 1.0	29	17.4 ± 3.3	26	9.6 ± 11.1	21	6.6 ± 5.1	93	10.7 ± 3.1
25.0-29.9 kg/m2	9	1.7 ± 1.5	9	4.6 ± 5.8	11	2.5 ± 2.1	18	9.1 ± 1.0	47	3.6 ± 1.9
30+ kg/m2	1	0.5 ± 1.1	0	0.0 ± 0.0	2	0.7 ± 1.1	1	2.3 ± 4.6	4	0.6 ± 0.7

Table 2.6. Blood pressure levels of participants in Hoa Binh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Normotensive	19	91.7 ± 16.3	30	82.3 ± 8.5	18	80.5 ± 10.5	21	58.3 ± 9.4	88	81.4 ± 6.3
	Hypertensive*	1	8.3 ± 16.3	7	17.7 ± 8.5	4	19.5 ± 10.5	15	41.7 ± 9.4	27	18.6 ± 6.3
	Rural										
	Normotensive	163	93.5 ± 5.6	132	77.8 ± 4.8	142	65.2 ± 12.1	102	54.1 ± 12.8	539	78.3 ± 4.0
	Hypertensive*	23	6.5 ± 5.6	47	22.2 ± 4.8	68	34.8 ± 12.1	95	45.9 ± 12.8	233	21.7 ± 4.0
	Total										
	Normotensive	182	93.4 ± 5.3	162	78.3 ± 4.4	160	67.5 ± 10.5	123	54.8 ± 10.8	627	78.7 ± 3.6
	Hypertensive*	24	6.6 ± 5.3	54	21.7 ± 4.4	72	32.5 ± 10.5	110	45.2 ± 10.8	260	21.3 ± 3.6
Women	*Urban*										
	Normotensive	22	96.7 ± 6.5	33	84.8 ± 10.6	36	88.3 ± 10.3	32	77.8 ± 7.8	123	88.4 ± 4.7
	Hypertensive*	1	3.3 ± 6.5	5	15.2 ± 10.6	4	11.7 ± 10.3	9	22.2 ± 7.8	19	11.6 ± 4.7
	Rural										
	Normotensive	224	89.8 ± 6.3	187	93.5 ± 7.8	172	83.6 ± 7.0	141	76.3 ± 4.9	724	87.9 ± 3.7
	Hypertensive*	15	10.2 ± 6.3	19	6.5 ± 7.8	46	16.4 ± 7.0	69	23.7 ± 4.9	149	12.1 ± 3.7
	Total										
	Normotensive	246	90.6 ± 5.7	220	92.5 ± 7.0	208	84.3 ± 6.2	173	76.6 ± 4.3	847	88.0 ± 3.3
	Hypertensive*	16	9.4 ± 5.7	24	7.5 ± 7.0	50	15.7 ± 6.2	78	23.4 ± 4.3	168	12.0 ± 3.3

* Systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or using hypertensive medications.

Table 2.7. Fasting blood glucose levels of participants in Hoa Binh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<5.6 mmol/L	17	87.5 ± 14.1	33	90.4 ± 10.6	16	75.6 ± 8.7	26	74.5 ± 8.6	92	83.0 ± 5.8
	5.6-6.1 mmol/L	3	12.5 ± 14.1	3	7.5 ± 7.5	2	10.0 ± 11.3	3	8.6 ± 0.5	11	9.8 ± 5.7
	6.1+ mmol/L	0	0.0 ± 0.0	1	2.1 ± 4.1	3	14.4 ± 19.4	6	16.9 ± 9.0	10	7.1 ± 6.1
	Rural										
	<5.6 mmol/L	166	93.7 ± 6.6	156	92.1 ± 8.1	184	96.5 ± 1.8	163	76.7 ± 24.7	669	92.3 ± 4.2
	5.6-6.1 mmol/L	12	5.4 ± 6.5	14	6.6 ± 7.9	11	1.6 ± 1.0	18	13.4 ± 9.8	55	5.6 ± 3.5
	6.1+ mmol/L	5	0.9 ± 0.8	6	1.3 ± 1.4	12	1.9 ± 1.1	16	9.9 ± 15.1	39	2.1 ± 1.5
	Total										
	<5.6 mmol/L	183	93.1 ± 6.1	189	91.9 ± 7.3	200	93.5 ± 2.0	189	76.3 ± 20.8	761	91.2 ± 3.7
	5.6-6.1 mmol/L	15	6.1 ± 6.1	17	6.7 ± 7.1	13	2.9 ± 1.9	21	12.6 ± 8.3	66	6.1 ± 3.2
	6.1+ mmol/L	5	0.8 ± 0.7	7	1.4 ± 1.3	15	3.7 ± 2.9	22	11.1 ± 12.7	49	2.7 ± 1.5
Women	*Urban*										
	<5.6 mmol/L	22	100.0 ± 0.0	30	80.7 ± 11.7	35	87.6 ± 1.9	33	80.0 ± 16.8	120	88.4 ± 4.0
	5.6-6.1 mmol/L	0	0.0 ± 0.0	4	8.6 ± 10.7	2	5.7 ± 6.3	5	12.3 ± 9.1	11	5.7 ± 3.7
	6.1+ mmol/L	0	0.0 ± 0.0	4	10.7 ± 3.5	3	6.7 ± 8.1	3	7.8 ± 8.2	10	5.9 ± 2.8
	Rural										
	<5.6 mmol/L	223	92.6 ± 11.7	193	97.8 ± 1.3	202	95.6 ± 5.1	182	85.6 ± 10.5	800	94.1 ± 4.3
	5.6-6.1 mmol/L	5	0.7 ± 0.6	6	1.1 ± 0.7	7	3.5 ± 5.1	14	12.5 ± 10.4	32	2.8 ± 1.7
	6.1+ mmol/L	8	6.7 ± 11.7	6	1.2 ± 1.3	6	0.9 ± 0.7	10	1.8 ± 1.1	30	3.0 ± 4.0
	Total										
	<5.6 mmol/L	245	93.5 ± 10.4	223	95.8 ± 1.8	237	94.5 ± 4.4	215	84.8 ± 9.2	920	93.4 ± 3.8
	5.6-6.1 mmol/L	5	0.6 ± 0.5	10	1.9 ± 1.4	9	3.8 ± 4.4	19	12.5 ± 8.9	43	3.2 ± 1.6
	6.1+ mmol/L	8	5.9 ± 10.3	10	2.3 ± 1.2	9	1.7 ± 1.3	13	2.7 ± 1.6	40	3.4 ± 3.5

Table 2.8. Fasting blood cholesterol levels of participants in Hoa Binh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5.0 mmol/L	18	91.7 ± 16.3	29	78.0 ± 5.2	15	65.6 ± 28.3	22	63.6 ± 28.3	84	76.3 ± 10.5
	5.0-6.1 mmol/L	2	8.3 ± 16.3	7	19.9 ± 8.4	6	34.4 ± 28.3	11	30.8 ± 21.3	26	22.4 ± 10.4
	6.2+ mmol/L	0	0.0 ± 0.0	1	2.1 ± 4.1	0	0.0 ± 0.0	2	5.6 ± 10.9	3	1.3 ± 1.8
	Rural										
	< 5.0 mmol/L	160	82.4 ± 14.6	149	68.4 ± 7.9	160	75.1 ± 10.7	157	71.4 ± 17.4	626	75.4 ± 6.6
	5.0-6.1 mmol/L	16	10.3 ± 16.2	24	21.0 ± 11.8	45	24.5 ± 10.7	36	22.8 ± 6.8	121	18.1 ± 7.4
	6.2+ mmol/L	7	7.3 ± 1.8	5	10.5 ± 4.0	3	0.4 ± 0.6	4	5.8 ± 10.8	19	6.5 ± 1.7
	Total										
	< 5.0 mmol/L	178	83.3 ± 13.3	178	69.5 ± 7.1	175	73.7 ± 10.0	179	70.2 ± 15.3	710	75.5 ± 5.9
	5.0-6.1 mmol/L	18	10.1 ± 14.7	31	20.9 ± 10.5	51	25.9 ± 10.1	47	24.1 ± 6.6	147	18.6 ± 6.6
	6.2+ mmol/L	7	6.6 ± 1.6	6	9.6 ± 3.5	3	0.4 ± 0.5	6	5.8 ± 9.2	22	5.9 ± 1.5
Women	*Urban*										
	< 5.0 mmol/L	19	84.9 ± 16.2	30	78.3 ± 3.5	26	67.8 ± 20.3	22	52.6 ± 22.0	97	73.8 ± 8.3
	5.0-6.1 mmol/L	3	15.1 ± 16.2	8	21.7 ± 3.5	11	25.9 ± 15.6	16	42.9 ± 24.3	38	23.8 ± 7.5
	6.2+ mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	3	6.3 ± 6.7	2	4.5 ± 4.4	5	2.4 ± 2.0
	Rural										
	< 5.0 mmol/L	209	85.4 ± 1.6	174	81.2 ± 3.2	158	68.0 ± 3.4	138	59.0 ± 8.5	679	76.9 ± 1.7
	5.0-6.1 mmol/L	24	14.1 ± 1.7	25	17.9 ± 3.2	49	27.6 ± 4.9	60	36.8 ± 3.4	158	21.1 ± 1.7
	6.2+ mmol/L	4	0.5 ± 0.4	5	0.8 ± 0.7	9	4.5 ± 6.4	8	4.1 ± 5.9	26	2.0 ± 1.7
	Total										
	< 5.0 mmol/L	228	85.3 ± 2.4	204	80.9 ± 2.9	184	67.9 ± 4.1	160	58.1 ± 8.0	776	76.5 ± 1.8
	5.0-6.1 mmol/L	27	14.2 ± 2.4	33	18.4 ± 2.9	60	27.3 ± 4.7	76	37.8 ± 4.7	196	21.5 ± 1.8
	6.2+ mmol/L	4	0.4 ± 0.4	5	0.7 ± 0.6	12	4.7 ± 5.6	10	4.2 ± 5.0	31	2.0 ± 1.5

Table 3.1. Smoking status of participants in Ha Noi

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Never	28	41.1 ± 15.7	23	19.5 ± 7.4	27	22.0 ± 11.7	44	29.2 ± 6.4	122	29.2 ± 6.7
	Ex-smoker	9	11.7 ± 8.2	26	22.5 ± 8.0	37	27.9 ± 8.6	53	36.3 ± 9.2	125	21.9 ± 4.4
	Current non-daily	9	13.3 ± 8.9	1	1.0 ± 1.9	6	3.6 ± 3.3	4	2.7 ± 2.3	20	6.3 ± 3.4
	Current daily	24	33.9 ± 16.7	59	57.0 ± 12.7	61	46.6 ± 8.9	47	31.9 ± 9.7	191	42.5 ± 7.2
	Rural										
	Never	17	28.6 ± 9.0	8	13.1 ± 8.9	11	15.2 ± 11.9	17	19.2 ± 8.1	53	20.0 ± 5.1
	Ex-smoker	9	15.6 ± 2.3	16	24.2 ± 7.6	23	34.9 ± 7.8	28	34.4 ± 11.8	76	24.8 ± 3.2
	Current non-daily	0	0.0 ± 0.0	3	4.8 ± 4.4	2	3.8 ± 5.0	2	3.6 ± 4.5	7	2.7 ± 1.8
	Current daily	31	55.8 ± 8.8	36	57.9 ± 9.5	32	46.0 ± 12.3	35	42.9 ± 15.8	134	52.6 ± 5.4
	Total										
	Never	45	33.9 ± 8.4	31	15.6 ± 6.2	38	18.2 ± 8.4	61	24.1 ± 5.2	175	23.9 ± 4.1
	Ex-smoker	18	14.0 ± 3.7	42	23.5 ± 5.6	60	31.8 ± 5.8	81	35.3 ± 7.5	201	23.6 ± 2.6
	Current non-daily	9	5.6 ± 3.8	4	3.3 ± 2.8	8	3.7 ± 3.1	6	3.1 ± 2.6	27	4.2 ± 1.8
	Current daily	55	46.5 ± 8.7	95	57.6 ± 7.6	93	46.3 ± 7.9	82	37.5 ± 9.4	325	48.3 ± 4.4
Women	*Urban*										
	Never	91	100.0 ± 0.0	119	98.3 ± 2.3	150	100.0 ± 0.0	180	99.1 ± 1.2	540	99.5 ± 0.6
	Ex-smoker	0	0.0 ± 0.0	1	0.8 ± 1.5	0	0.0 ± 0.0	1	0.5 ± 1.0	2	0.3 ± 0.4
	Current non-daily	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.4 ± 0.8	1	0.1 ± 0.1
	Current daily	0	0.0 ± 0.0	1	1.0 ± 1.9	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.2 ± 0.4
	Rural										
	Never	71	100.0 ± 0.0	88	98.3 ± 2.2	94	100.0 ± 0.0	99	95.2 ± 5.5	352	98.9 ± 0.9
	Ex-smoker	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	2	2.5 ± 3.2	2	0.3 ± 0.4
	Current non-daily	0	0.0 ± 0.0	2	1.7 ± 2.2	0	0.0 ± 0.0	2	2.3 ± 3.0	4	0.8 ± 0.7
	Total										
	Never	162	100.0 ± 0.0	207	98.3 ± 1.6	244	100.0 ± 0.0	279	97.1 ± 2.9	892	99.1 ± 0.6
	Ex-smoker	0	0.0 ± 0.0	1	0.3 ± 0.6	0	0.0 ± 0.0	3	1.5 ± 1.7	4	0.3 ± 0.3
	Current non-daily	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.2 ± 0.4	1	0.0 ± 0.1
	Current daily	0	0.0 ± 0.0	3	1.4 ± 1.5	0	0.0 ± 0.0	2	1.2 ± 1.6	5	0.5 ± 0.4

Table 3.2. Alcohol consumption of participants in Ha Noi

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Ever consume alc.	60	85.3 ± 11.1	97	87.6 ± 7.7	108	82.4 ± 6.6	111	72.5 ± 4.9	376	83.3 ± 4.8
	Consumed last 12ms	59	83.3 ± 10.9	92	81.9 ± 7.7	102	78.4 ± 7.6	101	65.5 ± 6.5	354	79.2 ± 4.9
	Hazardous drinking*	19	22.4 ± 7.6	22	21.9 ± 11.0	16	11.7 ± 5.9	8	5.3 ± 4.3	65	17.1 ± 4.1
	Harmful drinking†	9	10.8 ± 5.9	12	10.9 ± 8.3	7	5.8 ± 4.5	5	3.2 ± 2.4	33	8.4 ± 3.1
	Rural										
	Ever consume alc.	48	84.1 ± 11.9	57	91.3 ± 8.2	58	83.9 ± 10.2	72	88.4 ± 6.7	235	86.5 ± 5.6
	Consumed last 12ms	45	77.9 ± 11.6	53	85.7 ± 9.2	56	81.4 ± 9.1	65	78.5 ± 4.7	219	81.0 ± 5.5
	Hazardous drinking*	6	9.8 ± 5.7	11	19.8 ± 12.5	6	8.6 ± 5.1	7	8.1 ± 3.1	30	12.1 ± 4.3
	Harmful drinking†	2	3.8 ± 5.0	9	14.3 ± 9.2	11	15.9 ± 6.6	4	3.8 ± 5.3	26	9.7 ± 3.6
	Total										
	Ever consume alc.	108	84.6 ± 8.3	154	89.8 ± 5.8	166	83.3 ± 6.4	183	80.7 ± 4.2	611	85.2 ± 3.8
	Consumed last 12ms	104	80.2 ± 8.1	145	84.2 ± 6.3	158	80.1 ± 6.1	166	72.2 ± 4.0	573	80.2 ± 3.8
	Hazardous drinking*	25	15.1 ± 4.6	33	20.7 ± 8.8	22	10.0 ± 3.9	15	6.7 ± 2.6	95	14.3 ± 3.0
	Harmful drinking†	11	6.8 ± 3.8	21	13.0 ± 6.4	18	11.4 ± 4.2	9	3.5 ± 3.0	59	9.2 ± 2.5
Women	*Urban*										
	Ever consume alc.	18	20.6 ± 9.9	23	19.5 ± 8.2	24	16.5 ± 7.4	31	16.9 ± 5.2	96	18.8 ± 4.5
	Consumed last 12ms	16	16.8 ± 9.8	20	17.2 ± 7.5	21	14.9 ± 7.8	23	12.2 ± 4.3	80	15.7 ± 4.5
	Hazardous drinking*	3	3.5 ± 3.7	2	1.6 ± 2.2	1	0.7 ± 1.4	1	0.6 ± 1.3	7	1.9 ± 1.5
	Harmful drinking†	0	0.0 ± 0.0	1	0.7 ± 1.4	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.2 ± 0.3
	Rural										
	Ever consume alc.	10	11.6 ± 10.1	15	18.0 ± 10.4	12	12.6 ± 6.4	14	15.7 ± 10.7	51	14.1 ± 5.0
	Consumed last 12ms	8	8.6 ± 9.0	12	12.6 ± 7.6	11	10.6 ± 7.3	14	15.7 ± 10.7	45	11.1 ± 4.4
	Hazardous drinking*	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.8 ± 1.6	3	3.4 ± 3.3	4	0.6 ± 0.6
	Harmful drinking†	1	1.2 ± 2.3	0	0.0 ± 0.0	1	0.8 ± 1.6	1	1.1 ± 2.2	3	0.8 ± 0.9
	Total										
	Ever consume alc.	28	15.6 ± 7.1	38	18.6 ± 7.1	36	14.3 ± 4.9	45	16.3 ± 6.1	147	16.1 ± 3.4
	Consumed last 12ms	24	12.3 ± 6.6	32	14.4 ± 5.5	32	12.4 ± 5.3	37	14.0 ± 5.9	125	13.1 ± 3.1
	Hazardous drinking*	3	1.6 ± 1.7	2	0.6 ± 0.9	2	0.8 ± 1.1	4	2.1 ± 1.8	11	1.2 ± 0.7
	Harmful drinking†	1	0.7 ± 1.3	1	0.3 ± 0.5	1	0.5 ± 0.9	1	0.6 ± 1.1	4	0.5 ± 0.5

* Hazardous drinking: ≥4 standard drinks (men), ≥2 standard drinks (women); † Harmful drinking: ≥6 standard drinks (men), ≥4 standard drinks (women).

Table 3.3. Servings of fruit and vegetable in Ha Noi

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5 servings/day	55	79.1 ± 12.4	68	64.1 ± 5.9	91	69.7 ± 8.6	107	69.8 ± 7.0	321	71.7 ± 5.3
	≥ 5 servings/day	15	20.9 ± 12.4	40	35.9 ± 5.9	40	30.3 ± 8.6	44	30.2 ± 7.0	139	28.3 ± 5.3
	Rural										
	< 5 servings/day	45	78.5 ± 10.4	45	71.0 ± 9.9	53	77.8 ± 12.0	65	76.1 ± 10.0	208	76.0 ± 5.7
	≥ 5 servings/day	13	21.5 ± 10.4	18	29.0 ± 9.9	15	22.2 ± 12.0	18	23.9 ± 10.0	64	24.0 ± 5.7
	Total										
	< 5 servings/day	100	78.7 ± 8.0	113	68.3 ± 6.5	144	74.2 ± 7.7	172	73.0 ± 6.1	529	74.2 ± 4.0
	≥ 5 servings/day	28	21.3 ± 8.0	58	31.7 ± 6.5	55	25.8 ± 7.7	62	27.0 ± 6.1	203	25.8 ± 4.0
Women	*Urban*										
	< 5 servings/day	56	66.7 ± 11.7	68	56.8 ± 8.9	85	56.4 ± 9.1	123	68.5 ± 8.0	332	62.1 ± 5.4
	≥ 5 servings/day	34	33.3 ± 11.7	53	43.2 ± 8.9	65	43.6 ± 9.1	59	31.5 ± 8.0	211	37.9 ± 5.4
	Rural										
	< 5 servings/day	52	75.3 ± 14.1	72	80.2 ± 11.1	75	81.1 ± 9.4	78	77.1 ± 12.2	277	78.3 ± 6.4
	≥ 5 servings/day	20	24.7 ± 14.1	18	19.8 ± 11.1	18	18.9 ± 9.4	25	22.9 ± 12.2	81	21.7 ± 6.4
	Total										
	< 5 servings/day	108	71.4 ± 9.4	140	70.8 ± 7.5	160	70.4 ± 6.6	201	72.9 ± 7.4	609	71.2 ± 4.3
	≥ 5 servings/day	54	28.6 ± 9.4	71	29.2 ± 7.5	83	29.6 ± 6.6	84	27.1 ± 7.4	292	28.8 ± 4.3

Table 3.4. Physical activity levels of participants in Ha Noi

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Low*	28	41.9 ± 12.0	54	51.3 ± 7.6	49	35.6 ± 8.2	36	22.5 ± 9.9	167	39.8 ± 5.3
	Moderate†	24	34.4 ± 7.7	33	28.7 ± 8.3	50	38.8 ± 9.5	79	54.1 ± 6.5	186	36.9 ± 4.3
	High‡	18	23.7 ± 7.7	23	20.0 ± 5.5	32	25.7 ± 9.6	35	23.5 ± 6.8	108	23.3 ± 4.1
	Rural										
	Low*	16	31.1 ± 16.8	16	27.4 ± 13.6	21	27.8 ± 14.7	13	16.8 ± 10.3	66	27.7 ± 8.2
	Moderate†	11	17.7 ± 13.0	17	24.6 ± 15.0	18	25.4 ± 9.7	24	27.9 ± 10.6	70	22.6 ± 6.9
	High‡	31	51.2 ± 20.7	30	48.0 ± 16.6	30	46.8 ± 17.8	46	55.3 ± 13.9	137	49.7 ± 10.0
	Total										
	Low*	44	35.7 ± 10.9	70	36.7 ± 8.8	70	31.3 ± 8.9	49	19.6 ± 7.2	233	32.9 ± 5.2
	Moderate†	35	24.8 ± 8.2	50	26.2 ± 9.7	68	31.4 ± 6.8	103	40.7 ± 6.3	256	28.7 ± 4.3
	High‡	49	39.5 ± 12.3	53	37.0 ± 10.3	62	37.4 ± 10.7	81	39.8 ± 7.8	245	38.4 ± 6.0
Women	*Urban*										
	Low*	46	49.8 ± 8.5	46	38.3 ± 10.0	35	24.6 ± 10.0	28	15.3 ± 5.3	155	35.5 ± 4.7
	Moderate†	30	31.8 ± 10.2	51	42.0 ± 6.8	64	42.7 ± 11.7	95	52.5 ± 9.4	240	40.1 ± 5.2
	High‡	14	18.4 ± 10.0	24	19.7 ± 5.9	51	32.7 ± 9.2	61	32.1 ± 8.2	150	24.4 ± 4.7
	Rural										
	Low*	29	37.8 ± 12.1	15	18.0 ± 7.0	15	18.9 ± 8.3	20	20.0 ± 9.0	79	25.4 ± 5.2
	Moderate†	20	28.7 ± 8.7	30	32.8 ± 8.3	25	28.2 ± 4.7	36	34.3 ± 7.1	111	30.4 ± 4.0
	High‡	22	33.5 ± 15.4	44	49.2 ± 12.0	52	52.9 ± 10.8	46	45.6 ± 4.8	164	44.3 ± 6.8
	Total										
	Low*	75	43.2 ± 7.7	61	26.1 ± 5.8	50	21.3 ± 6.4	48	17.8 ± 5.3	234	29.8 ± 3.6
	Moderate†	50	30.1 ± 6.6	81	36.5 ± 5.7	89	34.5 ± 5.7	131	43.2 ± 5.8	351	34.6 ± 3.2
	High‡	36	26.7 ± 9.6	68	37.4 ± 7.6	103	44.2 ± 7.3	107	39.1 ± 4.7	314	35.6 ± 4.4

* Low: < 600 MET-minutes per week; † Moderate: 600-2999 MET-minutes per week; ‡ High: 3000+ MET-minutes per week

Table 3.5. Body mass index of participants in Ha Noi

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<18.5 kg/m2	3	2.6 ± 3.4	7	7.8 ± 6.2	9	7.4 ± 6.3	8	5.2 ± 3.0	27	5.4 ± 2.6
	18.5-22.9 kg/m2	36	48.4 ± 11.2	50	44.8 ± 8.7	60	45.1 ± 9.3	64	41.4 ± 9.3	210	45.7 ± 5.3
	23.0-24.9 kg/m2	18	30.7 ± 14.9	28	25.0 ± 8.7	34	26.2 ± 8.2	39	26.1 ± 10.1	119	27.5 ± 6.3
	25.0-29.9 kg/m2	12	17.0 ± 8.5	24	20.8 ± 9.4	27	19.8 ± 7.5	40	26.7 ± 9.5	103	20.0 ± 4.5
	30+ kg/m2	1	1.3 ± 2.5	2	1.6 ± 2.3	1	1.5 ± 3.0	1	0.5 ± 1.1	5	1.3 ± 1.3
	Rural										
	<18.5 kg/m2	16	27.1 ± 10.8	5	7.9 ± 9.2	8	11.1 ± 7.8	13	15.8 ± 7.6	42	16.6 ± 5.2
	18.5-22.9 kg/m2	29	48.8 ± 9.9	41	66.3 ± 10.1	36	55.0 ± 15.1	42	50.6 ± 7.0	148	55.4 ± 5.9
	23.0-24.9 kg/m2	5	8.0 ± 6.2	11	15.9 ± 11.7	13	17.5 ± 6.9	18	21.1 ± 10.2	47	13.9 ± 4.5
	25.0-29.9 kg/m2	6	12.4 ± 11.6	6	9.9 ± 6.0	12	16.4 ± 6.8	9	11.4 ± 7.5	33	12.6 ± 4.9
	30+ kg/m2	2	3.8 ± 5.0	0	0.0 ± 0.0	0	0.0 ± 0.0	1	1.1 ± 2.2	3	1.5 ± 1.9
	Total										
	<18.5 kg/m2	19	16.7 ± 6.4	12	7.9 ± 6.1	17	9.4 ± 5.2	21	10.6 ± 4.2	69	11.8 ± 3.1
	18.5-22.9 kg/m2	65	48.6 ± 7.4	91	57.9 ± 7.0	96	50.6 ± 9.3	106	46.1 ± 5.8	358	51.2 ± 4.1
	23.0-24.9 kg/m2	23	17.6 ± 7.2	39	19.4 ± 7.9	47	21.4 ± 5.3	57	23.5 ± 7.2	166	19.8 ± 3.7
	25.0-29.9 kg/m2	18	14.4 ± 7.6	30	14.2 ± 5.2	39	17.9 ± 5.1	49	18.9 ± 6.0	136	15.8 ± 3.4
	30+ kg/m2	3	2.7 ± 3.1	2	0.6 ± 0.9	1	0.7 ± 1.4	2	0.8 ± 1.2	8	1.4 ± 1.2
Women	*Urban*										
	<18.5 kg/m2	13	13.1 ± 7.6	6	4.9 ± 3.0	5	3.3 ± 2.4	7	4.3 ± 2.3	31	7.4 ± 2.9
	18.5-22.9 kg/m2	52	58.2 ± 14.2	67	55.8 ± 9.4	86	56.1 ± 8.2	83	43.9 ± 8.6	288	54.9 ± 6.1
	23.0-24.9 kg/m2	16	19.8 ± 12.9	30	24.4 ± 6.4	32	21.4 ± 7.0	43	22.7 ± 7.3	121	21.7 ± 5.3
	25.0-29.9 kg/m2	10	8.9 ± 6.9	18	14.9 ± 8.0	25	16.6 ± 3.8	49	28.3 ± 8.0	102	15.2 ± 3.5
	30+ kg/m2	0	0.0 ± 0.0	0	0.0 ± 0.0	3	2.6 ± 3.9	2	0.9 ± 1.2	5	0.8 ± 1.0
	Rural										
	<18.5 kg/m2	14	22.3 ± 16.4	8	9.8 ± 7.2	7	8.7 ± 7.2	12	11.3 ± 7.6	41	14.0 ± 6.3
	18.5-22.9 kg/m2	47	62.4 ± 12.9	69	75.2 ± 8.0	59	61.4 ± 9.3	55	54.4 ± 7.8	230	64.6 ± 5.6
	23.0-24.9 kg/m2	5	6.8 ± 7.5	12	13.8 ± 4.2	20	21.5 ± 9.5	19	17.6 ± 6.6	56	13.9 ± 3.8
	25.0-29.9 kg/m2	5	6.9 ± 4.0	1	1.1 ± 2.2	8	8.4 ± 6.3	16	16.0 ± 7.4	30	6.9 ± 2.4
	30+ kg/m2	1	1.6 ± 3.1	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.8 ± 1.5	2	0.6 ± 1.1

Total										
<18.5 kg/m2	27	18.2 ± 9.6	14	7.8 ± 4.5	12	6.4 ± 4.2	19	7.9 ± 4.1	72	11.1 ± 3.8
18.5-22.9 kg/m2	99	60.5 ± 9.5	136	67.5 ± 6.1	145	59.1 ± 6.4	138	49.3 ± 5.8	518	60.4 ± 4.1
23.0-24.9 kg/m2	21	12.7 ± 7.1	42	18.0 ± 3.6	52	21.5 ± 6.2	62	20.0 ± 4.9	177	17.3 ± 3.2
25.0-29.9 kg/m2	15	7.8 ± 3.8	19	6.6 ± 3.4	33	12.0 ± 3.9	65	21.9 ± 5.4	132	10.5 ± 2.0
30+ kg/m2	1	0.9 ± 1.7	0	0.0 ± 0.0	3	1.1 ± 1.7	3	0.8 ± 1.0	7	0.7 ± 0.8

Table 3.6. Blood pressure levels of participants in Ha Noi

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Normotensive	68	97.6 ± 3.2	103	92.9 ± 4.7	108	84.4 ± 7.7	93	60.5 ± 7.5	372	87.9 ± 2.8
	Hypertensive*	2	2.4 ± 3.2	8	7.1 ± 4.7	23	15.6 ± 7.7	59	39.5 ± 7.5	92	12.1 ± 2.8
	Rural										
	Normotensive	53	90.7 ± 9.0	49	77.8 ± 9.2	51	75.0 ± 9.1	58	68.5 ± 10.7	211	80.8 ± 4.9
	Hypertensive*	5	9.3 ± 9.0	14	22.2 ± 9.2	18	25.0 ± 9.1	25	31.5 ± 10.7	62	19.2 ± 4.9
	Total										
	Normotensive	121	93.6 ± 5.4	152	83.7 ± 5.9	159	79.2 ± 6.1	151	64.6 ± 6.6	583	83.8 ± 3.0
	Hypertensive*	7	6.4 ± 5.4	22	16.3 ± 5.9	41	20.8 ± 6.1	84	35.4 ± 6.6	154	16.2 ± 3.0
Women	*Urban*										
	Normotensive	90	98.9 ± 2.2	113	93.2 ± 4.5	128	85.1 ± 5.8	120	65.7 ± 6.4	451	89.0 ± 2.2
	Hypertensive*	1	1.1 ± 2.2	8	6.8 ± 4.5	23	14.9 ± 5.8	64	34.3 ± 6.4	96	11.0 ± 2.2
	Rural										
	Normotensive	70	97.9 ± 2.7	84	93.4 ± 6.1	85	92.0 ± 5.1	86	84.5 ± 8.4	325	93.5 ± 2.5
	Hypertensive*	2	2.1 ± 2.7	6	6.6 ± 6.1	9	8.0 ± 5.1	17	15.5 ± 8.4	34	6.5 ± 2.5
	Total										
	Normotensive	160	98.4 ± 1.8	197	93.3 ± 4.1	213	89.0 ± 3.8	206	75.4 ± 5.3	776	91.5 ± 1.7
	Hypertensive*	3	1.6 ± 1.8	14	6.7 ± 4.1	32	11.0 ± 3.8	81	24.6 ± 5.3	130	8.5 ± 1.7

* Systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or using hypertensive medications.

Table 3.7. Fasting blood glucose levels of participants in Ha Noi

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<5.6 mmol/L	66	96.9 ± 6.0	109	100.0 ± 0.0	120	96.0 ± 3.2	134	90.7 ± 4.9	429	96.6 ± 2.4
	5.6-6.1 mmol/L	2	3.1 ± 6.0	0	0.0 ± 0.0	2	1.4 ± 2.7	7	4.9 ± 3.3	11	2.2 ± 2.3
	6.1+ mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	4	2.6 ± 2.3	6	4.4 ± 3.4	10	1.3 ± 0.8
	Rural										
	<5.6 mmol/L	45	94.4 ± 10.9	53	98.1 ± 3.6	55	97.1 ± 3.7	58	88.5 ± 9.5	211	95.3 ± 4.3
	5.6-6.1 mmol/L	0	0.0 ± 0.0	1	1.9 ± 3.6	1	1.3 ± 2.5	4	5.2 ± 5.0	6	1.5 ± 1.3
	6.1+ mmol/L	2	5.6 ± 10.9	0	0.0 ± 0.0	1	1.7 ± 3.3	5	6.4 ± 6.0	8	3.2 ± 4.1
	Total										
	<5.6 mmol/L	111	95.6 ± 6.5	162	98.9 ± 2.1	175	96.5 ± 2.5	192	89.6 ± 5.4	640	95.9 ± 2.6
	5.6-6.1 mmol/L	2	1.4 ± 2.8	1	1.1 ± 2.1	3	1.3 ± 1.9	11	5.0 ± 3.0	17	1.8 ± 1.3
	6.1+ mmol/L	2	3.0 ± 5.9	0	0.0 ± 0.0	5	2.1 ± 2.0	11	5.4 ± 3.5	18	2.3 ± 2.2
Women	*Urban*										
	<5.6 mmol/L	87	98.7 ± 2.5	120	99.3 ± 1.4	139	97.5 ± 2.6	170	95.0 ± 4.1	516	98.0 ± 1.3
	5.6-6.1 mmol/L	1	1.3 ± 2.5	0	0.0 ± 0.0	2	1.6 ± 2.1	5	2.2 ± 2.6	8	1.2 ± 1.1
	6.1+ mmol/L	0	0.0 ± 0.0	1	0.7 ± 1.4	1	1.0 ± 1.9	5	2.8 ± 3.2	7	0.8 ± 0.8
	Rural										
	<5.6 mmol/L	59	100.0 ± 0.0	74	97.9 ± 2.6	71	97.8 ± 2.9	81	91.5 ± 6.8	285	97.9 ± 1.3
	5.6-6.1 mmol/L	0	0.0 ± 0.0	1	1.0 ± 1.9	0	0.0 ± 0.0	2	2.1 ± 2.7	3	0.5 ± 0.6
	6.1+ mmol/L	0	0.0 ± 0.0	1	1.1 ± 2.2	2	2.2 ± 2.9	5	6.4 ± 5.8	8	1.6 ± 1.1
	Total										
	<5.6 mmol/L	146	99.4 ± 1.1	194	98.5 ± 1.7	210	97.6 ± 2.0	251	93.3 ± 3.9	801	97.9 ± 0.9
	5.6-6.1 mmol/L	1	0.6 ± 1.1	1	0.6 ± 1.1	2	0.7 ± 1.0	7	2.2 ± 1.8	11	0.8 ± 0.6
	6.1+ mmol/L	0	0.0 ± 0.0	2	0.9 ± 1.4	3	1.6 ± 1.8	10	4.5 ± 3.2	15	1.2 ± 0.7

Table 3.8. Fasting blood cholesterol levels of participants in Ha Noi

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5.0 mmol/L	52	72.9 ± 16.5	67	59.9 ± 10.1	75	56.8 ± 9.1	80	53.9 ± 8.4	274	62.9 ± 6.9
	5.0-6.1 mmol/L	14	25.2 ± 17.0	32	31.7 ± 11.7	40	32.5 ± 5.1	55	37.5 ± 9.7	141	30.4 ± 7.0
	6.2+ mmol/L	1	1.9 ± 3.8	9	8.4 ± 5.2	11	10.7 ± 7.5	12	8.6 ± 6.5	33	6.7 ± 2.8
	Rural										
	< 5.0 mmol/L	39	81.9 ± 10.5	38	71.3 ± 11.4	39	70.3 ± 13.0	47	73.0 ± 10.9	163	75.1 ± 6.0
	5.0-6.1 mmol/L	6	14.1 ± 10.4	14	25.0 ± 7.8	15	24.5 ± 11.5	17	23.6 ± 11.5	52	20.8 ± 5.3
	6.2+ mmol/L	2	3.9 ± 4.9	2	3.7 ± 4.6	3	5.2 ± 6.8	3	3.4 ± 4.5	10	4.1 ± 2.8
	Total										
	< 5.0 mmol/L	91	77.8 ± 9.5	105	66.4 ± 7.8	114	63.7 ± 8.0	127	63.7 ± 6.9	437	69.5 ± 4.5
	5.0-6.1 mmol/L	20	19.2 ± 9.6	46	27.9 ± 6.7	55	28.4 ± 6.4	72	30.4 ± 7.5	193	25.2 ± 4.3
	6.2+ mmol/L	3	3.0 ± 3.2	11	5.7 ± 3.4	14	7.9 ± 5.1	15	5.9 ± 3.9	43	5.3 ± 2.0
Women	*Urban*										
	< 5.0 mmol/L	75	83.5 ± 11.8	88	73.0 ± 8.1	77	57.0 ± 10.4	71	38.0 ± 10.8	311	67.4 ± 5.6
	5.0-6.1 mmol/L	10	13.0 ± 11.8	29	24.6 ± 7.6	52	35.0 ± 8.5	81	48.2 ± 10.6	172	26.6 ± 5.4
	6.2+ mmol/L	3	3.5 ± 3.6	3	2.4 ± 2.5	12	8.0 ± 5.4	25	13.8 ± 4.9	43	6.0 ± 2.1
	Rural										
	< 5.0 mmol/L	47	70.7 ± 25.3	65	80.8 ± 11.6	51	71.6 ± 10.2	42	48.3 ± 12.5	205	71.2 ± 10.2
	5.0-6.1 mmol/L	12	29.3 ± 25.3	11	19.2 ± 11.6	19	23.1 ± 9.0	38	42.2 ± 6.9	80	26.5 ± 10.1
	6.2+ mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	3	5.3 ± 5.5	8	9.5 ± 7.9	11	2.3 ± 1.6
	Total										
	< 5.0 mmol/L	122	76.5 ± 14.9	153	77.7 ± 7.7	128	64.7 ± 7.3	113	42.9 ± 8.2	516	69.5 ± 6.2
	5.0-6.1 mmol/L	22	22.0 ± 14.9	40	21.4 ± 7.6	71	28.7 ± 6.2	119	45.3 ± 6.4	252	26.6 ± 6.0
	6.2+ mmol/L	3	1.6 ± 1.6	3	0.9 ± 1.0	15	6.5 ± 3.9	33	11.8 ± 4.6	54	4.0 ± 1.3

Table 4.1. Smoking status of participants in Thua Thien Hue

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Never	14	27.7 ± 15.4	10	11.7 ± 5.2	8	9.6 ± 2.7	16	21.2 ± 9.2	48	17.4 ± 5.4
	Ex-smoker	3	5.6 ± 10.9	15	20.7 ± 13.9	24	29.1 ± 5.1	22	27.7 ± 14.9	64	18.7 ± 6.0
	Current non-daily	2	4.6 ± 5.9	2	3.2 ± 4.1	1	1.0 ± 2.0	2	2.8 ± 5.4	7	3.1 ± 2.4
	Current daily	29	62.1 ± 16.8	52	64.4 ± 13.2	50	60.2 ± 6.1	38	48.3 ± 13.1	169	60.8 ± 7.2
	Rural										
	Never	23	24.7 ± 12.4	23	19.1 ± 6.9	26	14.9 ± 5.9	29	17.5 ± 6.2	101	19.9 ± 4.9
	Ex-smoker	13	12.8 ± 7.8	23	16.4 ± 5.3	33	22.0 ± 8.1	35	21.5 ± 6.8	104	17.0 ± 3.7
	Current non-daily	1	0.7 ± 1.3	1	0.8 ± 1.5	0	0.0 ± 0.0	2	0.9 ± 1.4	4	0.6 ± 0.7
	Current daily	60	61.7 ± 11.1	90	63.7 ± 6.1	105	63.1 ± 7.7	100	60.2 ± 8.1	355	62.5 ± 4.6
	Total										
	Never	37	25.7 ± 9.7	33	16.7 ± 4.9	34	13.0 ± 3.9	45	18.6 ± 5.1	149	19.0 ± 3.7
	Ex-smoker	16	10.4 ± 6.4	38	17.8 ± 5.8	57	24.6 ± 5.5	57	23.5 ± 6.6	168	17.6 ± 3.2
	Current non-daily	3	2.0 ± 2.2	3	1.6 ± 1.7	1	0.4 ± 0.7	4	1.5 ± 2.0	11	1.4 ± 0.9
	Current daily	89	61.9 ± 9.3	142	63.9 ± 6.0	155	62.0 ± 5.4	138	56.4 ± 6.9	524	61.9 ± 3.9
Women	*Urban*										
	Never	67	100.0 ± 0.0	76	95.9 ± 3.6	83	93.0 ± 5.2	63	78.0 ± 12.0	289	94.1 ± 2.3
	Ex-smoker	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	10	12.1 ± 6.5	10	1.6 ± 0.8
	Current non-daily	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	1	1.3 ± 2.5	1	0.2 ± 0.3
	Current daily	0	0.0 ± 0.0	3	4.1 ± 3.6	7	7.0 ± 5.2	7	8.6 ± 7.0	17	4.2 ± 2.0
	Rural										
	Never	138	97.7 ± 2.7	176	98.7 ± 1.7	166	90.6 ± 5.6	145	76.5 ± 7.5	625	93.3 ± 2.0
	Ex-smoker	1	0.7 ± 1.4	1	0.2 ± 0.5	2	1.1 ± 1.5	15	6.8 ± 3.7	19	1.6 ± 0.8
	Current non-daily	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.6 ± 1.2	2	1.2 ± 1.6	3	0.3 ± 0.4
	Current daily	2	1.5 ± 2.5	2	1.1 ± 1.6	15	7.6 ± 4.4	29	15.5 ± 6.9	48	4.9 ± 1.7
	Total	.		.							
	Never	205	98.5 ± 1.8	252	97.8 ± 1.6	249	91.5 ± 4.1	208	77.0 ± 6.4	914	93.5 ± 1.5
	Ex-smoker	1	0.5 ± 0.9	1	0.2 ± 0.3	2	0.7 ± 0.9	25	8.5 ± 3.2	29	1.6 ± 0.6
	Current non-daily	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.4 ± 0.8	3	1.2 ± 1.4	4	0.3 ± 0.3
	Current daily	2	1.0 ± 1.6	5	2.1 ± 1.6	22	7.4 ± 3.4	36	13.3 ± 5.2	65	4.6 ± 1.3

Table 4.2. Alcohol consumption of participants in Thua Thien Hue

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Ever consume alc.	41	87.6 ± 11.0	73	92.7 ± 5.5	74	89.2 ± 9.4	65	82.0 ± 7.7	253	89.0 ± 4.6
	Consumed last 12ms	40	85.7 ± 12.7	72	91.8 ± 5.6	71	85.7 ± 11.9	60	74.7 ± 11.9	243	86.4 ± 5.5
	Hazardous drinking*	10	21.1 ± 10.5	21	27.6 ± 10.0	24	29.0 ± 7.3	14	17.3 ± 11.0	69	24.7 ± 5.1
	Harmful drinking†	20	44.9 ± 12.4	29	35.5 ± 9.6	20	24.6 ± 7.4	14	16.7 ± 11.2	83	33.8 ± 5.5
	Rural										
	Ever consume alc.	86	86.2 ± 8.7	118	88.7 ± 8.0	142	85.1 ± 5.8	134	79.1 ± 6.6	480	86.0 ± 4.2
	Consumed last 12ms	85	85.5 ± 8.4	115	87.2 ± 7.8	139	83.5 ± 6.0	130	76.4 ± 5.4	469	84.5 ± 4.1
	Hazardous drinking*	20	19.7 ± 9.3	26	19.3 ± 10.7	32	17.4 ± 5.7	30	19.1 ± 6.9	108	19.0 ± 4.9
	Harmful drinking†	38	40.3 ± 10.4	45	36.5 ± 12.0	52	31.4 ± 10.4	24	13.1 ± 4.2	159	33.8 ± 5.7
	Total										
	Ever consume alc.	127	86.7 ± 6.9	191	90.0 ± 5.7	216	86.6 ± 5.0	199	80.0 ± 5.1	733	87.0 ± 3.2
	Consumed last 12ms	125	85.6 ± 7.0	187	88.7 ± 5.6	210	84.3 ± 5.8	190	75.9 ± 5.3	712	85.2 ± 3.3
	Hazardous drinking*	30	20.2 ± 7.1	47	22.0 ± 7.9	56	21.7 ± 4.5	44	18.5 ± 5.8	177	20.9 ± 3.7
	Harmful drinking†	58	41.8 ± 8.0	74	36.2 ± 8.7	72	28.9 ± 7.1	38	14.3 ± 4.6	242	33.8 ± 4.2
Women	*Urban*										
	Ever consume alc.	11	15.4 ± 7.6	8	10.1 ± 6.2	14	15.7 ± 9.0	6	7.6 ± 5.6	39	12.8 ± 3.8
	Consumed last 12ms	11	15.4 ± 7.6	7	8.7 ± 5.6	14	15.7 ± 9.0	6	7.6 ± 5.6	38	12.4 ± 3.8
	Hazardous drinking*	4	5.9 ± 3.7	4	4.9 ± 3.1	4	4.3 ± 4.0	2	2.2 ± 2.7	14	4.7 ± 1.8
	Harmful drinking†	1	1.5 ± 3.0	0	0.0 ± 0.0	2	2.1 ± 2.6	0	0.0 ± 0.0	3	1.0 ± 1.1
	Rural										
	Ever consume alc.	5	2.9 ± 2.4	9	5.5 ± 4.7	6	3.8 ± 3.4	11	4.9 ± 4.4	31	4.2 ± 1.9
	Consumed last 12ms	5	2.9 ± 2.4	8	4.7 ± 3.4	6	3.8 ± 3.4	10	4.4 ± 3.8	29	3.9 ± 1.6
	Hazardous drinking*	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.6 ± 1.2	4	1.6 ± 1.5	5	0.4 ± 0.4
	Harmful drinking†	2	1.0 ± 1.5	2	1.4 ± 1.8	1	0.6 ± 1.2	0	0.0 ± 0.0	5	0.9 ± 0.8
	Total										
	Ever consume alc.	16	7.3 ± 3.1	17	7.0 ± 3.7	20	8.1 ± 3.9	17	5.8 ± 3.5	70	7.2 ± 1.8
	Consumed last 12ms	16	7.3 ± 3.1	15	6.0 ± 2.9	20	8.1 ± 3.9	16	5.4 ± 3.1	67	6.8 ± 1.7
	Hazardous drinking*	4	2.1 ± 1.3	4	1.6 ± 1.0	5	1.9 ± 1.6	6	1.8 ± 1.4	19	1.9 ± 0.7
	Harmful drinking†	3	1.2 ± 1.4	2	0.9 ± 1.2	3	1.1 ± 1.2	0	0.0 ± 0.0	8	0.9 ± 0.6

* Hazardous drinking: ≥4 standard drinks (men), ≥2 standard drinks (women); † Harmful drinking: ≥6 standard drinks (men), ≥4 standard drinks (women).

Table 4.3. Servings of fruit and vegetable in Thua Thien Hue

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5 servings/day	40	83.7 ± 10.0	65	82.3 ± 7.9	70	84.9 ± 10.4	64	81.5 ± 9.9	239	83.3 ± 5.0
	≥ 5 servings/day	8	16.3 ± 10.0	13	17.7 ± 7.9	13	15.1 ± 10.4	14	18.5 ± 9.9	48	16.7 ± 5.0
	Rural										
	< 5 servings/day	86	87.4 ± 8.1	124	91.1 ± 5.0	142	86.0 ± 4.9	148	87.0 ± 7.9	500	88.3 ± 3.4
	≥ 5 servings/day	11	12.6 ± 8.1	13	8.9 ± 5.0	22	14.0 ± 4.9	19	13.0 ± 7.9	65	11.7 ± 3.4
	Total										
	< 5 servings/day	126	86.2 ± 6.4	189	88.3 ± 4.2	212	85.6 ± 4.9	212	85.2 ± 6.2	739	86.6 ± 2.8
	≥ 5 servings/day	19	13.8 ± 6.4	26	11.7 ± 4.2	35	14.4 ± 4.9	33	14.8 ± 6.2	113	13.4 ± 2.8
Women	*Urban*										
	< 5 servings/day	50	75.2 ± 12.9	65	81.7 ± 9.5	68	75.1 ± 11.0	65	82.6 ± 13.8	248	78.2 ± 6.0
	≥ 5 servings/day	17	24.8 ± 12.9	14	18.3 ± 9.5	22	24.9 ± 11.0	14	17.4 ± 13.8	67	21.8 ± 6.0
	Rural										
	< 5 servings/day	124	84.2 ± 13.2	157	86.7 ± 6.6	165	88.0 ± 5.6	165	85.1 ± 5.7	611	86.0 ± 4.7
	≥ 5 servings/day	17	15.8 ± 13.2	22	13.3 ± 6.6	20	12.0 ± 5.6	26	14.9 ± 5.7	85	14.0 ± 4.7
	Total										
	< 5 servings/day	174	81.1 ± 9.7	222	85.0 ± 5.5	233	83.4 ± 5.3	230	84.3 ± 5.9	859	83.3 ± 3.7
	≥ 5 servings/day	34	18.9 ± 9.7	36	15.0 ± 5.5	42	16.6 ± 5.3	40	15.7 ± 5.9	152	16.7 ± 3.7

Table 4.4. Physical activity levels of participants in Thua Thien Hue

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Low*	20	42.8 ± 12.3	28	35.0 ± 7.3	35	41.7 ± 7.8	20	26.1 ± 6.4	103	38.2 ± 5.1
	Moderate†	11	19.5 ± 15.0	19	25.0 ± 7.8	14	17.0 ± 9.7	30	37.9 ± 9.9	74	22.7 ± 6.1
	High‡	17	37.7 ± 11.5	32	39.9 ± 9.7	34	41.3 ± 16.0	27	36.0 ± 9.4	110	39.1 ± 6.3
	Rural										
	Low*	33	35.4 ± 11.4	34	27.0 ± 9.4	42	25.8 ± 6.6	48	28.4 ± 12.9	157	29.7 ± 5.3
	Moderate†	19	20.1 ± 9.5	24	18.2 ± 7.9	27	16.5 ± 7.6	33	21.5 ± 8.8	103	18.9 ± 4.5
	High‡	45	44.5 ± 8.1	79	54.8 ± 13.6	95	57.7 ± 7.7	85	50.1 ± 9.8	304	51.5 ± 5.7
	Total										
	Low*	53	37.9 ± 8.7	62	29.6 ± 6.8	77	31.6 ± 5.1	68	27.7 ± 9.0	260	32.5 ± 3.9
	Moderate†	30	19.9 ± 8.1	43	20.4 ± 5.9	41	16.7 ± 6.0	63	26.7 ± 6.8	177	20.2 ± 3.6
	High‡	62	42.2 ± 6.6	111	50.0 ± 9.7	129	51.7 ± 7.6	112	45.6 ± 7.3	414	47.3 ± 4.3
Women	*Urban*										
	Low*	30	43.0 ± 11.5	24	31.0 ± 13.1	22	24.1 ± 3.6	25	30.4 ± 9.4	101	32.8 ± 5.6
	Moderate†	25	37.6 ± 5.8	29	35.8 ± 9.5	35	39.3 ± 11.9	30	38.8 ± 19.5	119	37.6 ± 5.2
	High‡	12	19.5 ± 11.5	26	33.2 ± 13.8	33	36.6 ± 12.5	25	30.8 ± 11.7	96	29.5 ± 6.6
	Rural										
	Low*	59	41.2 ± 8.2	47	27.3 ± 10.1	33	15.8 ± 5.3	52	28.8 ± 8.6	191	28.9 ± 4.4
	Moderate†	20	15.8 ± 5.6	58	31.8 ± 7.8	46	26.9 ± 9.8	63	34.4 ± 9.2	187	26.3 ± 4.0
	High‡	61	43.0 ± 8.8	74	41.0 ± 8.4	106	57.3 ± 11.7	76	36.8 ± 7.9	317	44.8 ± 4.8
	Total										
	Low*	89	41.8 ± 6.7	71	28.5 ± 8.0	55	18.8 ± 3.6	77	29.3 ± 6.6	292	30.3 ± 3.5
	Moderate†	45	23.4 ± 4.2	87	33.1 ± 6.1	81	31.4 ± 7.6	93	35.8 ± 8.8	306	30.2 ± 3.2
	High‡	73	34.7 ± 7.0	100	38.4 ± 7.2	139	49.8 ± 8.7	101	34.9 ± 6.5	413	39.6 ± 3.9

* Low: < 600 MET-minutes per week; † Moderate: 600-2999 MET-minutes per week; ‡ High: 3000+ MET-minutes per week

Table 4.5. Body mass index of participants in Thua Thien Hue

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<18.5 kg/m2	7	12.2 ± 9.0	10	12.8 ± 7.1	12	14.5 ± 7.4	17	20.6 ± 10.4	46	13.9 ± 4.3
	18.5-22.9 kg/m2	31	68.9 ± 15.8	56	71.2 ± 5.7	49	58.6 ± 12.6	40	52.2 ± 10.3	176	65.2 ± 6.3
	23.0-24.9 kg/m2	7	13.4 ± 6.2	8	9.1 ± 6.2	7	8.8 ± 7.6	14	19.1 ± 7.0	36	11.6 ± 3.5
	25.0-29.9 kg/m2	3	5.5 ± 4.9	5	6.9 ± 5.2	15	18.2 ± 7.7	6	7.1 ± 7.0	29	9.2 ± 3.1
	30+ kg/m2	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	1	1.0 ± 1.9	1	0.1 ± 0.2
	Rural										
	<18.5 kg/m2	14	15.2 ± 7.2	19	12.4 ± 6.4	30	16.0 ± 5.1	37	21.3 ± 7.4	100	15.2 ± 3.5
	18.5-22.9 kg/m2	72	74.0 ± 8.3	103	75.8 ± 8.6	109	69.7 ± 6.0	105	62.5 ± 9.2	389	72.3 ± 4.3
	23.0-24.9 kg/m2	8	7.6 ± 5.5	11	9.4 ± 5.3	14	6.5 ± 4.4	17	11.3 ± 6.5	50	8.4 ± 2.8
	25.0-29.9 kg/m2	2	1.7 ± 2.2	3	1.7 ± 2.9	11	7.7 ± 3.0	7	4.1 ± 2.4	23	3.3 ± 1.4
	30+ kg/m2	1	1.4 ± 2.8	1	0.7 ± 1.4	0	0.0 ± 0.0	1	0.9 ± 1.7	3	0.8 ± 1.1
	Total										
	<18.5 kg/m2	21	14.2 ± 5.6	29	12.5 ± 4.9	42	15.5 ± 4.2	54	21.0 ± 6.0	146	14.7 ± 2.7
	18.5-22.9 kg/m2	103	72.3 ± 7.6	159	74.3 ± 6.1	158	65.7 ± 6.0	145	59.2 ± 7.0	565	69.9 ± 3.6
	23.0-24.9 kg/m2	15	9.6 ± 4.2	19	9.3 ± 4.1	21	7.4 ± 3.9	31	13.8 ± 4.9	86	9.5 ± 2.2
	25.0-29.9 kg/m2	5	2.9 ± 2.2	8	3.4 ± 2.6	26	11.5 ± 3.4	13	5.0 ± 2.8	52	5.3 ± 1.4
	30+ kg/m2	1	1.0 ± 1.9	1	0.5 ± 1.0	0	0.0 ± 0.0	2	0.9 ± 1.3	4	0.6 ± 0.7
Women	*Urban*										
	<18.5 kg/m2	18	27.2 ± 8.3	12	15.1 ± 8.8	8	8.8 ± 7.7	8	10.6 ± 7.4	46	16.6 ± 4.3
	18.5-22.9 kg/m2	39	57.6 ± 7.4	50	63.3 ± 12.5	46	51.3 ± 13.0	45	55.7 ± 1.7	180	57.5 ± 5.6
	23.0-24.9 kg/m2	8	12.4 ± 4.4	10	12.6 ± 6.6	25	27.7 ± 7.3	13	16.1 ± 1.3	56	16.8 ± 3.1
	25.0-29.9 kg/m2	2	2.7 ± 3.4	7	9.0 ± 4.6	10	11.3 ± 7.8	15	17.7 ± 7.6	34	8.8 ± 2.8
	30+ kg/m2	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.9 ± 1.8	0	0.0 ± 0.0	1	0.2 ± 0.5
	Rural										
	<18.5 kg/m2	26	17.9 ± 4.2	30	18.3 ± 8.7	33	18.3 ± 7.4	41	20.5 ± 5.5	130	18.5 ± 3.6
	18.5-22.9 kg/m2	100	70.6 ± 7.1	105	57.1 ± 5.8	104	53.7 ± 9.1	107	56.7 ± 9.0	416	60.2 ± 3.8
	23.0-24.9 kg/m2	13	9.5 ± 5.8	26	14.8 ± 6.0	27	14.2 ± 4.9	28	14.8 ± 4.7	94	13.1 ± 2.9
	25.0-29.9 kg/m2	2	2.0 ± 2.7	17	9.0 ± 4.5	21	13.9 ± 6.2	13	6.6 ± 6.4	53	7.7 ± 2.4
	30+ kg/m2	0	0.0 ± 0.0	1	0.8 ± 1.5	0	0.0 ± 0.0	2	1.4 ± 1.8	3	0.5 ± 0.6

Total										
<18.5 kg/m2	44	21.2 ± 4.0	42	17.2 ± 6.5	41	14.9 ± 5.5	49	17.4 ± 4.5	176	17.9 ± 2.8
18.5-22.9 kg/m2	139	66.0 ± 5.3	155	59.2 ± 5.7	150	52.8 ± 7.5	152	56.3 ± 6.2	596	59.3 ± 3.1
23.0-24.9 kg/m2	21	10.5 ± 4.1	36	14.1 ± 4.6	52	19.1 ± 4.1	41	15.2 ± 3.2	150	14.4 ± 2.2
25.0-29.9 kg/m2	4	2.2 ± 2.1	24	9.0 ± 3.4	31	12.9 ± 4.8	28	10.1 ± 5.0	87	8.1 ± 1.8
30+ kg/m2	0	0.0 ± 0.0	1	0.5 ± 1.0	1	0.3 ± 0.7	2	1.0 ± 1.3	4	0.4 ± 0.4

Table 4.6. Blood pressure levels of participants in Thua Thien Hue

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Normotensive	45	94.5 ± 4.9	68	86.2 ± 10.4	55	65.8 ± 6.1	42	54.0 ± 10.6	210	80.3 ± 4.1
	Hypertensive*	3	5.5 ± 4.9	11	13.8 ± 10.4	28	34.2 ± 6.1	36	46.0 ± 10.6	78	19.7 ± 4.1
	Rural										
	Normotensive	90	93.8 ± 5.6	120	84.7 ± 9.6	131	81.6 ± 6.5	106	64.1 ± 8.8	447	84.5 ± 4.1
	Hypertensive*	7	6.2 ± 5.6	17	15.3 ± 9.6	33	18.4 ± 6.5	61	35.9 ± 8.8	118	15.5 ± 4.1
	Total										
	Normotensive	135	94.1 ± 4.1	188	85.2 ± 7.3	186	75.8 ± 4.7	148	60.9 ± 6.9	657	83.1 ± 3.1
	Hypertensive*	10	5.9 ± 4.1	28	14.8 ± 7.3	61	24.2 ± 4.7	97	39.1 ± 6.9	196	16.9 ± 3.1
Women	*Urban*										
	Normotensive	65	96.4 ± 4.5	70	89.3 ± 5.5	78	86.0 ± 8.9	58	71.9 ± 10.7	271	88.3 ± 3.4
	Hypertensive*	2	3.6 ± 4.5	9	10.7 ± 5.5	12	14.0 ± 8.9	23	28.1 ± 10.7	46	11.7 ± 3.4
	Rural										
	Normotensive	138	96.9 ± 3.2	169	95.4 ± 3.1	159	84.5 ± 4.5	135	70.8 ± 9.9	601	89.7 ± 2.3
	Hypertensive*	3	3.1 ± 3.2	10	4.6 ± 3.1	26	15.5 ± 4.5	56	29.2 ± 9.9	95	10.3 ± 2.3
	Total										
	Normotensive	203	96.7 ± 2.6	239	93.3 ± 2.8	237	85.0 ± 4.3	193	71.1 ± 7.6	872	89.2 ± 1.9
	Hypertensive*	5	3.3 ± 2.6	19	6.7 ± 2.8	38	15.0 ± 4.3	79	28.9 ± 7.6	141	10.8 ± 1.9

* Systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or using hypertensive medications.

Table 4.7. Fasting blood glucose levels of participants in Thua Thien Hue

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<5.6 mmol/L	43	97.0 ± 5.9	69	92.9 ± 4.7	78	97.4 ± 3.2	71	92.9 ± 5.3	261	95.3 ± 2.6
	5.6-6.1 mmol/L	2	3.0 ± 5.9	1	1.5 ± 3.0	0	0.0 ± 0.0	1	1.5 ± 3.0	4	1.6 ± 2.2
	6.1+ mmol/L	0	0.0 ± 0.0	4	5.6 ± 5.2	2	2.6 ± 3.2	5	5.6 ± 5.7	11	3.1 ± 1.9
	Rural										
	<5.6 mmol/L	96	100.0 ± 0.0	132	98.9 ± 1.6	152	96.7 ± 2.1	163	98.6 ± 1.8	543	98.7 ± 0.7
	5.6-6.1 mmol/L	0	0.0 ± 0.0	1	0.7 ± 1.4	3	1.8 ± 1.8	1	0.7 ± 1.3	5	0.7 ± 0.6
	6.1+ mmol/L	0	0.0 ± 0.0	1	0.4 ± 0.7	4	1.5 ± 1.5	1	0.7 ± 1.4	6	0.5 ± 0.4
	Total										
	<5.6 mmol/L	139	99.0 ± 2.0	201	96.9 ± 1.9	230	96.9 ± 1.8	234	96.8 ± 2.1	804	97.6 ± 1.0
	5.6-6.1 mmol/L	2	1.0 ± 2.0	2	1.0 ± 1.4	3	1.1 ± 1.1	2	0.9 ± 1.3	9	1.0 ± 0.8
	6.1+ mmol/L	0	0.0 ± 0.0	5	2.1 ± 1.7	6	1.9 ± 1.5	6	2.3 ± 2.1	17	1.4 ± 0.7
Women	*Urban*										
	<5.6 mmol/L	67	100.0 ± 0.0	77	98.5 ± 3.0	83	94.4 ± 5.2	68	87.2 ± 9.5	295	96.4 ± 2.0
	5.6-6.1 mmol/L	0	0.0 ± 0.0	1	1.5 ± 3.0	1	0.9 ± 1.8	6	7.7 ± 6.9	8	1.7 ± 1.4
	6.1+ mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	4	4.7 ± 4.7	4	5.1 ± 4.6	8	1.9 ± 1.3
	Rural										
	<5.6 mmol/L	139	100.0 ± 0.0	175	99.2 ± 1.5	176	96.9 ± 2.4	181	96.5 ± 2.7	671	98.5 ± 0.8
	5.6-6.1 mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	2	0.8 ± 1.1	2	0.5 ± 0.6	4	0.3 ± 0.3
	6.1+ mmol/L	0	0.0 ± 0.0	1	0.8 ± 1.5	5	2.3 ± 1.8	4	2.9 ± 2.6	10	1.2 ± 0.8
	Total										
	<5.6 mmol/L	206	100.0 ± 0.0	252	99.0 ± 1.4	259	96.0 ± 2.4	249	93.6 ± 3.5	966	97.8 ± 0.9
	5.6-6.1 mmol/L	0	0.0 ± 0.0	1	0.5 ± 1.0	3	0.8 ± 1.0	8	2.8 ± 2.2	12	0.8 ± 0.5
	6.1+ mmol/L	0	0.0 ± 0.0	1	0.5 ± 1.0	9	3.2 ± 2.1	8	3.6 ± 2.3	18	1.4 ± 0.7

Table 4.8. Fasting blood cholesterol levels of participants in Thua Thien Hue

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5.0 mmol/L	38	86.0 ± 11.0	53	69.1 ± 17.6	58	71.5 ± 10.3	47	61.6 ± 13.1	196	74.3 ± 7.3
	5.0-6.1 mmol/L	7	14.0 ± 11.0	21	30.9 ± 17.6	20	25.9 ± 8.6	24	31.7 ± 11.4	72	24.3 ± 7.1
	6.2+ mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	2	2.6 ± 3.2	5	6.7 ± 2.8	7	1.4 ± 0.8
	Rural										
	< 5.0 mmol/L	73	78.7 ± 5.4	105	80.5 ± 8.7	118	72.9 ± 7.1	132	80.6 ± 5.2	428	78.3 ± 3.8
	5.0-6.1 mmol/L	22	19.9 ± 4.7	25	16.5 ± 8.2	36	22.6 ± 4.9	32	18.6 ± 5.5	115	19.2 ± 3.4
	6.2+ mmol/L	1	1.4 ± 2.8	4	3.0 ± 3.1	5	4.4 ± 3.1	1	0.8 ± 1.5	11	2.5 ± 1.6
	Total										
	< 5.0 mmol/L	111	81.1 ± 5.1	158	76.8 ± 8.2	176	72.4 ± 5.9	179	74.6 ± 5.5	624	77.0 ± 3.5
	5.0-6.1 mmol/L	29	17.9 ± 4.8	46	21.2 ± 8.0	56	23.8 ± 4.4	56	22.8 ± 5.2	187	20.9 ± 3.3
	6.2+ mmol/L	1	1.0 ± 1.9	4	2.0 ± 2.1	7	3.7 ± 2.3	6	2.7 ± 1.4	18	2.1 ± 1.1
Women	*Urban*										
	< 5.0 mmol/L	48	74.9 ± 13.3	56	72.8 ± 9.6	57	63.0 ± 14.8	39	48.1 ± 17.4	200	67.7 ± 6.7
	5.0-6.1 mmol/L	17	25.1 ± 13.3	19	23.9 ± 8.9	23	27.0 ± 9.4	30	39.4 ± 12.3	89	27.1 ± 5.7
	6.2+ mmol/L	0	0.0 ± 0.0	3	3.3 ± 4.5	8	10.0 ± 6.9	9	12.5 ± 9.6	20	5.2 ± 2.6
	Rural										
	< 5.0 mmol/L	121	84.3 ± 8.6	139	78.8 ± 7.4	113	61.4 ± 7.3	95	47.8 ± 9.3	468	71.8 ± 4.1
	5.0-6.1 mmol/L	16	14.8 ± 8.5	32	18.0 ± 7.4	59	31.5 ± 5.8	75	43.4 ± 9.7	182	23.9 ± 4.0
	6.2+ mmol/L	2	1.0 ± 1.3	5	3.2 ± 4.0	12	7.1 ± 2.9	17	8.8 ± 3.8	36	4.3 ± 1.6
	Total										
	< 5.0 mmol/L	169	81.0 ± 7.3	195	76.8 ± 5.9	170	62.0 ± 7.1	134	47.9 ± 8.4	668	70.4 ± 3.5
	5.0-6.1 mmol/L	33	18.4 ± 7.2	51	19.9 ± 5.7	82	29.9 ± 5.0	105	42.1 ± 7.7	271	25.0 ± 3.3
	6.2+ mmol/L	2	0.6 ± 0.9	8	3.3 ± 3.0	20	8.1 ± 3.1	26	10.0 ± 4.0	56	4.6 ± 1.4

Table 5.1. Smoking status of participants in Binh Dinh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Never	16	35.2 ± 19.4	8	13.3 ± 3.6	3	4.3 ± 8.4	11	18.7 ± 13.1	38	19.1 ± 6.9
	Ex-smoker	4	7.7 ± 9.9	10	15.0 ± 12.9	11	18.7 ± 9.6	18	29.6 ± 14.8	43	14.9 ± 6.2
	Current non-daily	1	2.5 ± 4.9	2	4.9 ± 6.5	1	1.5 ± 3.0	0	0.0 ± 0.0	4	2.9 ± 2.9
	Current daily	28	54.7 ± 12.0	40	66.8 ± 16.6	43	75.5 ± 13.1	30	51.8 ± 15.1	141	63.1 ± 7.8
	Rural										
	Never	33	22.6 ± 6.8	14	10.9 ± 4.5	16	11.2 ± 5.7	22	13.0 ± 4.9	85	15.2 ± 3.1
	Ex-smoker	25	18.8 ± 5.7	26	18.2 ± 7.0	41	23.2 ± 6.3	51	27.2 ± 9.3	143	20.4 ± 3.5
	Current non-daily	9	4.6 ± 3.3	2	0.9 ± 1.2	3	2.0 ± 2.0	3	2.0 ± 2.0	17	2.5 ± 1.3
	Current daily	79	54.0 ± 8.1	103	70.1 ± 6.0	120	63.6 ± 6.0	112	57.8 ± 9.3	414	61.9 ± 3.8
	Total										
	Never	49	25.8 ± 7.1	22	11.5 ± 3.4	19	9.3 ± 4.7	33	14.3 ± 4.8	123	16.2 ± 2.9
	Ex-smoker	29	16.0 ± 4.9	36	17.3 ± 6.2	52	22.0 ± 5.3	69	27.8 ± 7.9	186	19.0 ± 3.0
	Current non-daily	10	4.1 ± 2.8	4	1.9 ± 1.9	4	1.8 ± 1.7	3	1.5 ± 1.6	21	2.6 ± 1.2
	Current daily	107	54.2 ± 6.8	143	69.2 ± 6.3	163	66.9 ± 5.7	142	56.4 ± 8.0	555	62.2 ± 3.5
Women	*Urban*										
	Never	57	98.2 ± 3.6	68	100.0 ± 0.0	71	100.0 ± 0.0	63	97.3 ± 5.2	259	99.1 ± 1.3
	Ex-smoker	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	2	2.7 ± 5.2	2	0.3 ± 0.6
	Current non-daily	1	1.8 ± 3.6	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.6 ± 1.2
	Rural										
	Never	1	1.0 ± 1.9	0	0.0 ± 0.0	0	0.0 ± 0.0	3	1.3 ± 1.6	4	0.5 ± 0.6
	Ex-smoker	0	0.0 ± 0.0	1	0.3 ± 0.6	2	1.7 ± 2.3	2	0.9 ± 1.5	5	0.6 ± 0.6
	Current daily	235	98.8 ± 1.7	256	99.8 ± 0.5	260	98.8 ± 1.7	263	97.6 ± 1.9	1014	98.9 ± 0.7
	Total										
	Never	1	0.5 ± 0.9	1	0.2 ± 0.5	2	1.2 ± 1.7	2	0.7 ± 1.1	6	0.6 ± 0.5
	Ex-smoker	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0
	Current non-daily	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.4 ± 0.8	3	1.2 ± 1.4	4	0.3 ± 0.3
	Current daily	2	1.0 ± 1.6	5	2.1 ± 1.6	22	7.4 ± 3.4	36	13.3 ± 5.2	65	4.6 ± 1.3

Table 5.2. Alcohol consumption of participants in Binh Dinh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Ever consume alc.	45	92.8 ± 5.8	59	98.0 ± 3.9	53	91.5 ± 5.0	49	82.8 ± 10.9	206	93.4 ± 2.8
	Consumed last 12ms	44	90.3 ± 4.9	58	94.7 ± 6.7	52	90.0 ± 5.4	44	73.6 ± 7.3	198	90.1 ± 3.2
	Hazardous drinking*	18	38.2 ± 15.6	17	26.8 ± 13.4	16	25.6 ± 14.9	7	10.9 ± 6.5	58	28.6 ± 7.7
	Harmful drinking†	11	20.0 ± 11.1	19	27.2 ± 14.3	13	23.9 ± 11.0	9	15.9 ± 11.5	52	23.0 ± 6.8
	Rural										
	Ever consume alc.	132	91.0 ± 3.3	134	92.5 ± 3.2	165	91.5 ± 3.7	164	86.3 ± 4.6	595	91.1 ± 1.8
	Consumed last 12ms	127	88.4 ± 4.3	132	91.3 ± 3.6	154	85.8 ± 5.9	141	73.7 ± 4.9	554	87.2 ± 2.3
	Hazardous drinking*	35	21.1 ± 6.9	35	23.0 ± 5.3	41	21.9 ± 4.8	38	18.8 ± 6.3	149	21.7 ± 3.2
	Harmful drinking†	55	39.0 ± 9.1	51	33.4 ± 9.1	56	31.2 ± 7.8	23	10.8 ± 6.6	185	32.2 ± 4.8
	Total										
	Ever consume alc.	177	91.4 ± 2.9	193	94.0 ± 2.5	218	91.5 ± 3.0	213	85.5 ± 4.4	801	91.7 ± 1.5
	Consumed last 12ms	171	88.9 ± 3.4	190	92.2 ± 3.2	206	86.9 ± 4.5	185	73.7 ± 4.1	752	87.9 ± 1.9
	Hazardous drinking*	53	25.4 ± 6.5	52	24.0 ± 5.3	57	22.9 ± 5.4	45	17.0 ± 5.0	207	23.5 ± 3.1
	Harmful drinking†	66	34.3 ± 7.4	70	31.7 ± 7.7	69	29.2 ± 6.4	32	12.0 ± 5.7	237	29.8 ± 3.9
Women	*Urban*										
	Ever consume alc.	16	27.4 ± 13.0	21	30.3 ± 6.4	18	24.5 ± 13.9	15	22.6 ± 12.0	70	27.2 ± 5.8
	Consumed last 12ms	14	24.2 ± 11.1	16	22.8 ± 9.8	16	22.0 ± 14.7	10	15.1 ± 10.0	56	22.2 ± 6.0
	Hazardous drinking*	2	3.2 ± 3.9	3	4.0 ± 3.3	1	1.5 ± 3.0	2	2.7 ± 5.2	8	3.1 ± 1.9
	Harmful drinking†	0	0.0 ± 0.0	1	1.5 ± 3.0	1	1.3 ± 2.5	1	1.7 ± 3.3	3	1.0 ± 1.2
	Rural										
	Ever consume alc.	37	20.4 ± 5.0	33	15.3 ± 4.4	41	19.8 ± 6.6	24	11.0 ± 5.3	135	17.3 ± 2.7
	Consumed last 12ms	25	13.8 ± 4.4	20	9.7 ± 4.5	22	9.8 ± 3.9	13	6.0 ± 2.8	80	10.5 ± 2.2
	Hazardous drinking*	5	3.2 ± 2.5	6	2.8 ± 2.3	2	0.7 ± 1.0	1	0.6 ± 1.2	14	2.1 ± 1.1
	Harmful drinking†	1	0.3 ± 0.6	1	0.3 ± 0.5	1	0.6 ± 1.1	0	0.0 ± 0.0	3	0.3 ± 0.4
	Total										
	Ever consume alc.	53	22.3 ± 5.0	54	19.4 ± 3.7	59	21.0 ± 6.1	39	13.7 ± 5.0	205	19.9 ± 2.5
	Consumed last 12ms	39	16.6 ± 4.4	36	13.2 ± 4.2	38	13.0 ± 4.8	23	8.1 ± 3.2	136	13.5 ± 2.3
	Hazardous drinking*	7	3.2 ± 2.1	9	3.1 ± 1.9	3	0.9 ± 1.1	3	1.1 ± 1.5	22	2.4 ± 1.0
	Harmful drinking†	1	0.2 ± 0.5	2	0.6 ± 0.9	2	0.7 ± 1.0	1	0.4 ± 0.8	6	0.5 ± 0.4

* Hazardous drinking: ≥4 standard drinks (men), ≥2 standard drinks (women); † Harmful drinking: ≥6 standard drinks (men), ≥4 standard drinks (women).

Table 5.3. Servings of fruit and vegetable in Binh Dinh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5 servings/day	47	96.2 ± 4.9	54	87.6 ± 11.3	51	87.1 ± 12.1	48	83.9 ± 13.4	200	89.9 ± 5.3
	≥ 5 servings/day	2	3.8 ± 4.9	6	12.4 ± 11.3	7	12.9 ± 12.1	10	16.1 ± 13.4	25	10.1 ± 5.3
	Rural										
	< 5 servings/day	131	90.1 ± 3.8	122	84.1 ± 7.0	156	90.4 ± 4.6	166	88.7 ± 4.9	575	87.9 ± 2.9
	≥ 5 servings/day	14	9.9 ± 3.8	23	15.9 ± 7.0	18	9.6 ± 4.6	21	11.3 ± 4.9	76	12.1 ± 2.9
	Total										
	< 5 servings/day	178	91.6 ± 3.1	176	85.0 ± 6.0	207	89.5 ± 4.7	214	87.6 ± 4.9	775	88.4 ± 2.6
	≥ 5 servings/day	16	8.4 ± 3.1	29	15.0 ± 6.0	25	10.5 ± 4.7	31	12.4 ± 4.9	101	11.6 ± 2.6
Women	*Urban*										
	< 5 servings/day	50	86.3 ± 9.7	60	88.1 ± 10.0	67	96.0 ± 5.1	60	92.0 ± 7.3	237	89.7 ± 4.8
	≥ 5 servings/day	8	13.7 ± 9.7	8	11.9 ± 10.0	3	4.0 ± 5.1	5	8.0 ± 7.3	24	10.3 ± 4.8
	Rural										
	< 5 servings/day	162	91.5 ± 3.5	175	92.0 ± 3.3	173	93.3 ± 4.0	197	97.7 ± 2.1	707	93.0 ± 1.8
	≥ 5 servings/day	17	8.5 ± 3.5	14	8.0 ± 3.3	15	6.7 ± 4.0	5	2.3 ± 2.1	51	7.0 ± 1.8
	Total										
	< 5 servings/day	212	90.2 ± 3.6	235	91.0 ± 3.6	240	94.0 ± 3.2	257	96.4 ± 2.3	944	92.1 ± 1.8
	≥ 5 servings/day	25	9.8 ± 3.6	22	9.0 ± 3.6	18	6.0 ± 3.2	10	3.6 ± 2.3	75	7.9 ± 1.8

Table 5.4. Physical activity levels of participants in Binh Dinh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Low*	7	12.5 ± 11.4	8	13.7 ± 6.9	10	17.2 ± 5.4	13	21.9 ± 7.8	38	14.9 ± 4.7
	Moderate†	12	24.3 ± 8.1	8	15.0 ± 10.5	13	22.5 ± 8.2	17	26.9 ± 20.1	50	20.9 ± 5.3
	High‡	30	63.2 ± 10.3	44	71.2 ± 11.7	35	60.3 ± 3.3	29	51.2 ± 15.2	138	64.2 ± 5.6
	Rural										
	Low*	16	9.9 ± 3.9	19	12.7 ± 3.5	29	15.9 ± 3.7	37	16.4 ± 4.3	101	12.8 ± 2.0
	Moderate†	9	5.6 ± 4.3	23	16.5 ± 4.6	18	10.1 ± 5.8	18	10.2 ± 4.7	68	10.8 ± 2.5
	High‡	121	84.5 ± 4.4	103	70.7 ± 3.7	133	73.9 ± 6.1	133	73.4 ± 7.0	490	76.4 ± 2.4
	Total										
	Low*	23	10.6 ± 4.1	27	13.0 ± 3.2	39	16.3 ± 3.1	50	17.6 ± 3.8	139	13.4 ± 1.9
	Moderate†	21	10.3 ± 3.8	31	16.1 ± 4.4	31	13.5 ± 4.8	35	14.1 ± 5.9	118	13.4 ± 2.3
	High‡	151	79.1 ± 4.2	147	70.9 ± 4.1	168	70.2 ± 4.5	162	68.3 ± 6.4	628	73.2 ± 2.3
Women	*Urban*										
	Low*	17	30.1 ± 12.4	15	20.9 ± 18.0	8	11.4 ± 7.7	11	16.9 ± 5.5	51	21.4 ± 7.5
	Moderate†	13	21.6 ± 10.0	22	31.6 ± 13.0	14	20.4 ± 9.6	20	31.0 ± 11.3	69	25.9 ± 6.0
	High‡	28	48.3 ± 7.7	31	47.4 ± 27.3	49	68.2 ± 8.2	34	52.2 ± 14.9	142	52.7 ± 9.9
	Rural										
	Low*	39	21.8 ± 4.8	44	22.7 ± 4.7	32	16.6 ± 4.8	42	20.6 ± 6.1	157	20.8 ± 2.5
	Moderate†	21	10.7 ± 3.1	17	8.6 ± 3.0	31	16.8 ± 7.0	24	11.3 ± 6.0	93	11.4 ± 2.2
	High‡	119	67.5 ± 6.0	128	68.7 ± 5.6	127	66.6 ± 8.0	139	68.2 ± 8.2	513	67.8 ± 3.4
	Total										
	Low*	56	24.0 ± 4.8	59	22.3 ± 5.9	40	15.3 ± 4.1	53	19.7 ± 4.9	208	20.9 ± 2.7
	Moderate†	34	13.6 ± 3.5	39	14.8 ± 4.1	45	17.7 ± 5.7	44	15.8 ± 5.3	162	15.2 ± 2.3
	High‡	147	62.3 ± 4.9	159	63.0 ± 8.4	176	67.0 ± 6.3	173	64.5 ± 7.2	655	63.8 ± 3.6

* Low: < 600 MET-minutes per week; † Moderate: 600-2999 MET-minutes per week; ‡ High: 3000+ MET-minutes per week

Table 5.5. Body mass index of participants in Binh Dinh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<18.5 kg/m2	11	23.3 ± 20.4	7	10.4 ± 7.0	7	14.5 ± 20.5	13	22.4 ± 9.3	38	16.7 ± 8.4
	18.5-22.9 kg/m2	23	44.7 ± 24.8	33	53.7 ± 12.4	39	65.3 ± 19.5	33	58.3 ± 17.6	128	53.7 ± 10.3
	23.0-24.9 kg/m2	7	15.8 ± 13.3	10	15.9 ± 6.1	9	14.8 ± 8.3	5	9.0 ± 7.7	31	14.9 ± 5.2
	25.0-29.9 kg/m2	7	14.2 ± 8.3	10	19.9 ± 11.2	3	5.5 ± 10.7	8	10.4 ± 16.6	28	14.0 ± 5.6
	30+ kg/m2	1	2.0 ± 3.9	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.7 ± 1.3
	Rural										
	<18.5 kg/m2	22	15.7 ± 7.7	25	18.3 ± 6.2	45	23.7 ± 5.9	74	38.8 ± 6.3	166	20.9 ± 3.7
	18.5-22.9 kg/m2	102	68.3 ± 11.2	90	60.0 ± 8.8	103	58.6 ± 4.6	101	55.2 ± 6.6	396	62.0 ± 5.1
	23.0-24.9 kg/m2	12	8.5 ± 5.1	20	14.9 ± 4.4	23	13.3 ± 6.2	9	3.7 ± 2.1	64	11.1 ± 2.6
	25.0-29.9 kg/m2	10	7.4 ± 5.6	10	6.8 ± 3.8	9	4.5 ± 3.0	4	2.3 ± 2.1	33	6.0 ± 2.4
	Total										
	<18.5 kg/m2	33	17.6 ± 7.7	32	16.2 ± 4.9	52	21.1 ± 7.1	87	35.0 ± 5.3	204	19.8 ± 3.5
	18.5-22.9 kg/m2	125	62.4 ± 10.5	123	58.3 ± 7.3	142	60.4 ± 6.4	134	55.9 ± 6.5	524	59.9 ± 4.6
	23.0-24.9 kg/m2	19	10.4 ± 5.1	30	15.2 ± 3.6	32	13.7 ± 5.0	14	4.9 ± 2.4	95	12.1 ± 2.4
	25.0-29.9 kg/m2	17	9.1 ± 4.7	20	10.3 ± 4.1	12	4.7 ± 3.7	12	4.2 ± 4.2	61	8.1 ± 2.3
	30+ kg/m2	1	0.5 ± 1.0	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.2 ± 0.3
Women	*Urban*										
	<18.5 kg/m2	8	13.9 ± 4.4	10	14.3 ± 12.4	9	12.4 ± 6.9	7	10.1 ± 10.1	34	13.3 ± 4.8
	18.5-22.9 kg/m2	41	70.6 ± 6.6	35	52.6 ± 8.9	36	50.2 ± 7.8	31	48.8 ± 12.6	143	57.5 ± 4.4
	23.0-24.9 kg/m2	7	12.0 ± 3.9	15	20.8 ± 12.2	11	16.3 ± 9.4	16	24.1 ± 8.7	49	17.4 ± 4.9
	25.0-29.9 kg/m2	1	1.8 ± 3.6	8	12.2 ± 5.9	12	16.7 ± 9.3	10	15.3 ± 4.2	31	10.2 ± 3.1
	30+ kg/m2	1	1.7 ± 3.3	0	0.0 ± 0.0	3	4.3 ± 3.5	1	1.7 ± 3.3	5	1.7 ± 1.4
	Rural										
	<18.5 kg/m2	40	21.4 ± 5.3	38	19.8 ± 6.2	36	16.6 ± 8.4	57	25.3 ± 6.2	171	20.4 ± 3.3
	18.5-22.9 kg/m2	109	62.2 ± 4.7	105	55.5 ± 4.9	115	62.8 ± 10.0	103	51.2 ± 4.4	432	58.6 ± 3.1
	23.0-24.9 kg/m2	23	12.9 ± 4.4	28	16.0 ± 5.6	20	10.4 ± 5.1	23	12.0 ± 3.6	94	13.2 ± 2.6
	25.0-29.9 kg/m2	7	3.5 ± 2.5	18	8.7 ± 4.7	19	10.0 ± 4.9	21	11.1 ± 4.1	65	7.7 ± 2.1
	30+ kg/m2	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.2 ± 0.4	1	0.3 ± 0.6	2	0.1 ± 0.1
	Total										
	<18.5 kg/m2	48	19.4 ± 4.1	48	18.4 ± 5.6	45	15.5 ± 6.5	64	21.8 ± 5.3	205	18.6 ± 2.8

18.5-22.9 kg/m2	150	64.4 ± 3.8	140	54.7 ± 4.3	151	59.6 ± 7.7	134	50.7 ± 4.4	575	58.3 ± 2.6
23.0-24.9 kg/m2	30	12.7 ± 3.4	43	17.3 ± 5.2	31	11.9 ± 4.5	39	14.8 ± 3.4	143	14.3 ± 2.3
25.0-29.9 kg/m2	8	3.0 ± 2.1	26	9.6 ± 3.8	31	11.7 ± 4.3	31	12.1 ± 3.3	96	8.3 ± 1.8
30+ kg/m2	1	0.4 ± 0.9	0	0.0 ± 0.0	4	1.3 ± 1.0	2	0.6 ± 0.9	7	0.5 ± 0.4

Table 5.6. Blood pressure levels of participants in Binh Dinh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Normotensive	44	91.0 ± 10.9	43	73.7 ± 12.1	47	81.5 ± 8.6	35	60.9 ± 11.8	169	79.7 ± 6.0
	Hypertensive*	5	9.0 ± 10.9	17	26.3 ± 12.1	11	18.5 ± 8.6	24	39.1 ± 11.8	57	20.3 ± 6.0
	Rural										
	Normotensive	131	90.2 ± 5.2	108	73.5 ± 8.6	132	71.8 ± 7.7	125	65.5 ± 8.1	496	78.0 ± 3.9
	Hypertensive*	15	9.8 ± 5.2	37	26.5 ± 8.6	48	28.2 ± 7.7	63	34.5 ± 8.1	163	22.0 ± 3.9
	Total										
	Normotensive	175	90.4 ± 4.7	151	73.5 ± 7.1	179	74.5 ± 6.1	160	64.4 ± 6.8	665	78.4 ± 3.3
	Hypertensive*	20	9.6 ± 4.7	54	26.5 ± 7.1	59	25.5 ± 6.1	87	35.6 ± 6.8	220	21.6 ± 3.3
Women	*Urban*										
	Normotensive	58	100.0 ± 0.0	59	86.7 ± 4.9	57	79.9 ± 9.2	33	51.1 ± 13.2	207	85.2 ± 3.1
	Hypertensive*	0	0.0 ± 0.0	9	13.3 ± 4.9	14	20.1 ± 9.2	32	48.9 ± 13.2	55	14.8 ± 3.1
	Rural										
	Normotensive	178	99.1 ± 1.7	181	96.2 ± 3.8	160	82.4 ± 5.8	145	69.0 ± 8.2	664	90.2 ± 2.2
	Hypertensive*	1	0.9 ± 1.7	8	3.8 ± 3.8	31	17.6 ± 5.8	60	31.0 ± 8.2	100	9.8 ± 2.2
	Total										
	Normotensive	236	99.4 ± 1.2	240	93.7 ± 3.1	217	81.7 ± 4.9	178	64.8 ± 7.0	871	88.9 ± 1.8
	Hypertensive*	1	0.6 ± 1.2	17	6.3 ± 3.1	45	18.3 ± 4.9	92	35.2 ± 7.0	155	11.1 ± 1.8

* Systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or using hypertensive medications.

Table 5.7. Fasting blood glucose levels of participants in Binh Dinh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<5.6 mmol/L	46	100.0 ± 0.0	55	93.0 ± 6.2	54	94.5 ± 10.7	54	91.1 ± 5.8	209	95.4 ± 3.2
	5.6-6.1 mmol/L	0	0.0 ± 0.0	1	3.3 ± 6.5	0	0.0 ± 0.0	3	5.3 ± 4.4	4	1.7 ± 2.4
	6.1+ mmol/L	0	0.0 ± 0.0	2	3.7 ± 4.4	3	5.5 ± 10.7	2	3.6 ± 7.1	7	2.8 ± 2.9
	Rural										
	<5.6 mmol/L	137	95.9 ± 3.9	139	99.0 ± 1.2	168	97.4 ± 2.7	177	95.8 ± 3.0	621	97.2 ± 1.5
	5.6-6.1 mmol/L	4	4.1 ± 3.9	0	0.0 ± 0.0	2	0.8 ± 1.2	4	2.2 ± 2.7	10	1.8 ± 1.4
	6.1+ mmol/L	0	0.0 ± 0.0	2	1.0 ± 1.2	3	1.8 ± 2.2	3	2.1 ± 2.1	8	1.0 ± 0.6
	Total										
	<5.6 mmol/L	183	96.9 ± 2.9	194	97.4 ± 1.9	222	96.6 ± 3.6	231	94.7 ± 2.7	830	96.7 ± 1.4
	5.6-6.1 mmol/L	4	3.1 ± 2.9	1	0.9 ± 1.7	2	0.6 ± 0.8	7	2.9 ± 2.3	14	1.8 ± 1.2
	6.1+ mmol/L	0	0.0 ± 0.0	4	1.7 ± 1.5	6	2.8 ± 3.4	5	2.4 ± 2.3	15	1.4 ± 0.9
Women	*Urban*										
	<5.6 mmol/L	56	100.0 ± 0.0	62	93.9 ± 9.5	64	91.2 ± 5.1	48	76.3 ± 10.2	230	93.2 ± 3.6
	5.6-6.1 mmol/L	0	0.0 ± 0.0	4	6.1 ± 9.5	2	2.8 ± 3.4	6	9.5 ± 9.2	12	3.8 ± 3.5
	6.1+ mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	4	6.0 ± 3.0	9	14.2 ± 9.0	13	3.0 ± 1.3
	Rural										
	<5.6 mmol/L	170	98.4 ± 3.1	180	96.9 ± 2.2	177	94.7 ± 3.7	183	92.4 ± 4.1	710	96.3 ± 1.5
	5.6-6.1 mmol/L	1	0.8 ± 1.5	3	1.5 ± 1.7	2	1.0 ± 1.3	7	2.4 ± 2.6	13	1.3 ± 0.9
	6.1+ mmol/L	1	0.8 ± 1.5	3	1.6 ± 1.8	7	4.3 ± 3.6	10	5.1 ± 4.0	21	2.4 ± 1.2
	Total										
	<5.6 mmol/L	226	98.9 ± 2.2	242	96.1 ± 3.0	241	93.8 ± 3.0	231	88.7 ± 3.9	940	95.5 ± 1.5
	5.6-6.1 mmol/L	1	0.6 ± 1.1	7	2.7 ± 2.8	4	1.5 ± 1.3	13	4.1 ± 2.9	25	1.9 ± 1.1
	6.1+ mmol/L	1	0.6 ± 1.1	3	1.2 ± 1.3	11	4.8 ± 2.8	19	7.2 ± 3.7	34	2.6 ± 1.0

Table 5.8. Fasting blood cholesterol levels of participants in Binh Dinh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5.0 mmol/L	39	86.1 ± 13.2	46	82.1 ± 12.0	39	69.5 ± 12.2	33	56.8 ± 17.4	157	78.2 ± 6.9
	5.0-6.1 mmol/L	6	11.9 ± 14.3	12	17.9 ± 12.0	12	20.7 ± 9.7	22	36.4 ± 22.6	52	18.4 ± 7.1
	6.2+ mmol/L	1	2.0 ± 3.9	0	0.0 ± 0.0	6	9.8 ± 5.5	4	6.8 ± 9.6	11	3.4 ± 2.0
	Rural										
	< 5.0 mmol/L	108	75.5 ± 8.9	95	67.3 ± 8.5	121	70.0 ± 7.7	145	81.1 ± 5.6	469	72.3 ± 4.5
	5.0-6.1 mmol/L	28	19.4 ± 6.0	42	30.6 ± 9.2	48	27.8 ± 7.6	35	17.7 ± 5.2	153	24.7 ± 4.1
	6.2+ mmol/L	5	5.1 ± 4.9	3	2.1 ± 2.3	4	2.2 ± 2.0	2	1.2 ± 1.5	14	3.0 ± 1.9
	Total										
	< 5.0 mmol/L	147	78.1 ± 7.4	141	71.3 ± 7.0	160	69.9 ± 6.5	178	75.5 ± 5.9	626	73.8 ± 3.8
	5.0-6.1 mmol/L	34	17.5 ± 5.7	54	27.2 ± 7.4	60	25.9 ± 6.1	57	22.1 ± 6.6	205	23.1 ± 3.5
	6.2+ mmol/L	6	4.3 ± 3.8	3	1.5 ± 1.7	10	4.3 ± 2.1	6	2.5 ± 2.5	25	3.1 ± 1.5
Women	*Urban*										
	< 5.0 mmol/L	39	69.6 ± 6.1	42	65.8 ± 14.3	33	46.7 ± 23.5	12	18.3 ± 13.1	126	57.1 ± 7.5
	5.0-6.1 mmol/L	16	28.4 ± 7.3	23	32.7 ± 12.5	22	31.5 ± 13.3	32	51.6 ± 16.6	93	33.4 ± 6.0
	6.2+ mmol/L	1	2.0 ± 3.9	1	1.5 ± 3.0	15	21.8 ± 11.0	19	30.1 ± 11.5	36	9.5 ± 3.2
	Rural										
	< 5.0 mmol/L	118	68.1 ± 8.5	138	74.2 ± 6.8	105	55.5 ± 6.6	77	36.9 ± 6.9	438	62.9 ± 3.9
	5.0-6.1 mmol/L	46	27.3 ± 7.6	46	25.0 ± 6.9	58	32.0 ± 6.3	96	48.2 ± 6.7	246	30.5 ± 3.7
	6.2+ mmol/L	7	4.7 ± 3.5	2	0.8 ± 1.2	23	12.5 ± 6.4	27	14.9 ± 4.9	59	6.6 ± 1.9
	Total										
	< 5.0 mmol/L	157	68.5 ± 6.5	180	71.9 ± 6.3	138	53.2 ± 7.8	89	32.6 ± 6.1	564	61.4 ± 3.5
	5.0-6.1 mmol/L	62	27.6 ± 5.9	69	27.0 ± 6.1	80	31.9 ± 5.8	128	49.0 ± 6.4	339	31.3 ± 3.1
	6.2+ mmol/L	8	4.0 ± 2.8	3	1.0 ± 1.2	38	14.9 ± 5.5	46	18.4 ± 4.6	95	7.4 ± 1.7

Table 6.1. Smoking status of participants in Ho Chi Minh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Never	39	31.6 ± 10.5	58	34.6 ± 6.8	60	32.5 ± 6.4	80	35.5 ± 6.6	237	33.1 ± 4.8
	Ex-smoker	12	10.9 ± 5.1	28	15.7 ± 4.6	33	19.5 ± 6.0	40	18.4 ± 5.5	113	14.9 ± 2.8
	Current non-daily	6	5.9 ± 4.6	7	3.7 ± 2.7	0	0.0 ± 0.0	5	2.4 ± 2.3	18	3.7 ± 2.0
	Current daily	63	51.5 ± 11.9	80	46.1 ± 7.6	83	48.0 ± 8.0	94	43.6 ± 4.8	320	48.4 ± 5.5
	Rural										
	Never	10	36.4 ± 3.1	7	18.8 ± 3.9	9	24.2 ± 10.8	7	16.4 ± 9.9	33	26.9 ± 2.8
	Ex-smoker	2	8.3 ± 16.3	2	4.6 ± 4.6	3	10.7 ± 14.6	7	16.1 ± 5.3	14	8.2 ± 7.4
	Current non-daily	2	8.1 ± 9.4	1	2.6 ± 5.0	0	0.0 ± 0.0	1	2.1 ± 4.1	4	4.3 ± 4.2
	Current daily	13	47.1 ± 9.7	28	74.0 ± 4.9	25	65.1 ± 16.2	29	65.5 ± 10.2	95	60.6 ± 5.3
	Total										
	Never	49	32.5 ± 8.6	65	31.9 ± 5.6	69	31.3 ± 5.7	87	32.4 ± 5.8	270	32.0 ± 4.0
	Ex-smoker	14	10.5 ± 5.1	30	13.8 ± 3.9	36	18.1 ± 5.6	47	18.0 ± 4.7	127	13.7 ± 2.6
	Current non-daily	8	6.3 ± 4.1	8	3.5 ± 2.4	0	0.0 ± 0.0	6	2.4 ± 2.0	22	3.8 ± 1.8
	Current daily	76	50.7 ± 10.0	108	50.9 ± 6.3	108	50.6 ± 7.2	123	47.2 ± 4.3	415	50.5 ± 4.6
Women	*Urban*										
	Never	126	94.7 ± 3.3	198	96.2 ± 2.7	224	96.2 ± 2.3	224	97.7 ± 1.9	772	95.8 ± 1.6
	Ex-smoker	5	3.2 ± 2.9	4	1.5 ± 1.7	3	1.6 ± 1.7	1	0.2 ± 0.4	13	2.0 ± 1.3
	Current non-daily	0	0.0 ± 0.0	1	0.3 ± 0.7	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.1 ± 0.2
	Current daily	4	2.2 ± 2.0	5	2.0 ± 1.8	4	2.2 ± 2.0	5	2.1 ± 1.9	18	2.1 ± 1.0
	Rural										
	Never	25	100.0 ± 0.0	37	100.0 ± 0.0	41	91.4 ± 10.7	50	90.6 ± 3.9	153	97.3 ± 2.2
	Ex-smoker	0	0.0 ± 0.0	0	0.0 ± 0.0	2	4.2 ± 8.2	1	2.2 ± 4.4	3	1.1 ± 1.7
	Current non-daily	0	0.0 ± 0.0	0	0.0 ± 0.0	2	4.5 ± 4.4	4	7.2 ± 0.6	6	1.6 ± 0.9
	Current daily	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0
	Total										
	Never	151	95.6 ± 2.7	235	96.8 ± 2.3	265	95.5 ± 2.5	274	96.6 ± 1.7	925	96.0 ± 1.4
	Ex-smoker	5	2.6 ± 2.5	4	1.3 ± 1.5	5	2.0 ± 1.9	2	0.5 ± 0.8	16	1.9 ± 1.1
	Current non-daily	0	0.0 ± 0.0	1	0.3 ± 0.6	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.1 ± 0.2
	Current daily	4	1.8 ± 1.7	5	1.6 ± 1.5	6	2.6 ± 1.8	9	2.9 ± 1.6	24	2.0 ± 0.9

Table 6.2. Alcohol consumption of participants in Ho Chi Minh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Ever consume alc.	101	79.5 ± 9.2	140	78.1 ± 8.1	132	76.3 ± 7.7	157	71.9 ± 6.0	530	77.7 ± 4.7
	Consumed last 12ms	96	75.3 ± 9.6	133	73.9 ± 8.8	123	72.2 ± 8.4	142	64.8 ± 5.5	494	73.3 ± 5.0
	Hazardous drinking*	35	26.0 ± 10.4	45	25.7 ± 6.6	43	25.0 ± 6.1	32	15.3 ± 5.2	155	24.8 ± 4.7
	Harmful drinking†	25	21.9 ± 10.1	28	15.7 ± 7.0	28	17.6 ± 6.3	22	9.4 ± 3.7	103	18.0 ± 4.7
	Rural										
	Ever consume alc.	25	91.9 ± 9.4	33	83.7 ± 7.3	30	84.1 ± 18.9	28	62.8 ± 18.5	116	85.5 ± 6.0
	Consumed last 12ms	24	89.3 ± 10.5	33	83.7 ± 7.3	27	73.4 ± 6.9	27	60.4 ± 22.0	111	82.2 ± 5.4
	Hazardous drinking*	6	21.6 ± 4.9	11	32.0 ± 25.0	9	22.7 ± 13.4	11	23.8 ± 26.0	37	25.3 ± 8.9
	Harmful drinking†	6	18.6 ± 18.5	9	21.1 ± 10.2	4	9.4 ± 12.4	6	14.0 ± 8.6	25	17.3 ± 8.6
	Total										
	Ever consume alc.	126	81.7 ± 7.7	173	79.0 ± 6.8	162	77.5 ± 7.1	185	70.4 ± 5.9	646	79.0 ± 4.0
	Consumed last 12ms	120	77.8 ± 8.1	166	75.6 ± 7.4	150	72.4 ± 7.2	169	64.1 ± 5.8	605	74.8 ± 4.2
	Hazardous drinking*	41	25.2 ± 8.6	56	26.7 ± 7.0	52	24.6 ± 5.6	43	16.6 ± 6.0	192	24.8 ± 4.2
	Harmful drinking†	31	21.3 ± 8.9	37	16.7 ± 6.0	32	16.4 ± 5.7	28	10.2 ± 3.4	128	17.9 ± 4.2
Women	*Urban*										
	Ever consume alc.	19	17.7 ± 7.6	32	14.5 ± 5.9	31	13.1 ± 6.2	21	9.7 ± 4.8	103	15.0 ± 3.7
	Consumed last 12ms	15	13.8 ± 7.7	25	11.7 ± 5.1	29	12.2 ± 6.1	17	7.8 ± 4.4	86	12.2 ± 3.6
	Hazardous drinking*	5	3.3 ± 2.6	11	4.5 ± 2.6	2	0.9 ± 1.2	3	1.4 ± 1.5	21	2.9 ± 1.3
	Harmful drinking†	5	3.5 ± 2.8	3	1.1 ± 1.2	6	2.5 ± 1.7	1	0.4 ± 0.8	15	2.3 ± 1.2
	Rural										
	Ever consume alc.	0	0.0 ± 0.0	3	7.0 ± 7.0	7	15.8 ± 16.4	4	7.2 ± 0.6	14	5.9 ± 3.9
	Consumed last 12ms	0	0.0 ± 0.0	2	3.9 ± 7.7	4	9.2 ± 12.5	3	4.8 ± 4.7	9	3.5 ± 3.4
	Hazardous drinking*	0	0.0 ± 0.0	0	0.0 ± 0.0	1	2.4 ± 4.7	2	3.5 ± 3.8	3	0.8 ± 1.0
	Harmful drinking†	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0
	Total										
	Ever consume alc.	19	14.8 ± 6.4	35	13.3 ± 5.1	38	13.5 ± 5.8	25	9.3 ± 4.0	117	13.5 ± 3.2
	Consumed last 12ms	15	11.5 ± 6.4	27	10.5 ± 4.5	33	11.8 ± 5.5	20	7.3 ± 3.8	95	10.9 ± 3.1
	Hazardous drinking*	5	2.7 ± 2.2	11	3.8 ± 2.2	2	0.7 ± 1.0	3	1.2 ± 1.2	21	2.4 ± 1.1
	Harmful drinking†	5	2.9 ± 2.3	3	1.0 ± 1.0	7	2.5 ± 1.6	3	0.9 ± 0.9	18	2.0 ± 1.0

* Hazardous drinking: ≥4 standard drinks (men), ≥2 standard drinks (women); † Harmful drinking: ≥6 standard drinks (men), ≥4 standard drinks (women).

Table 6.3. Servings of fruit and vegetable in Ho Chi Minh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5 servings/day	97	78.8 ± 7.3	136	79.7 ± 8.2	142	81.0 ± 7.0	179	82.3 ± 5.3	554	79.8 ± 4.1
	≥ 5 servings/day	24	21.2 ± 7.3	37	20.3 ± 8.2	33	19.0 ± 7.0	39	17.7 ± 5.3	133	20.2 ± 4.1
	Rural										
	< 5 servings/day	22	81.9 ± 15.2	30	78.4 ± 10.4	28	79.2 ± 14.6	36	86.0 ± 7.0	116	80.6 ± 7.6
	≥ 5 servings/day	4	18.1 ± 15.2	9	21.6 ± 10.4	8	20.8 ± 14.6	6	14.0 ± 7.0	27	19.4 ± 7.6
	Total										
	< 5 servings/day	119	79.4 ± 6.6	166	79.4 ± 7.0	170	80.7 ± 6.3	215	82.9 ± 4.6	670	80.0 ± 3.7
	≥ 5 servings/day	28	20.6 ± 6.6	46	20.6 ± 7.0	41	19.3 ± 6.3	45	17.1 ± 4.6	160	20.0 ± 3.7
Women	*Urban*										
	< 5 servings/day	101	72.0 ± 5.7	156	75.4 ± 8.4	173	75.8 ± 4.2	180	78.1 ± 6.2	610	74.4 ± 3.5
	≥ 5 servings/day	34	28.0 ± 5.7	52	24.6 ± 8.4	56	24.2 ± 4.2	51	21.9 ± 6.2	193	25.6 ± 3.5
	Rural										
	< 5 servings/day	19	78.9 ± 7.3	26	68.5 ± 22.8	41	90.8 ± 9.0	42	80.2 ± 8.9	128	78.5 ± 7.5
	≥ 5 servings/day	5	21.1 ± 7.3	11	31.5 ± 22.8	4	9.2 ± 9.0	10	19.8 ± 8.9	30	21.5 ± 7.5
	Total										
	< 5 servings/day	120	73.1 ± 4.9	182	74.3 ± 7.9	214	78.1 ± 3.8	222	78.5 ± 5.4	738	75.1 ± 3.2
	≥ 5 servings/day	39	26.9 ± 4.9	63	25.7 ± 7.9	60	21.9 ± 3.8	61	21.5 ± 5.4	223	24.9 ± 3.2

Table 6.4. Physical activity levels of participants in Ho Chi Minh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Low*	57	48.9 ± 11.3	91	55.8 ± 10.9	87	49.2 ± 6.7	111	49.8 ± 7.8	346	51.2 ± 5.8
	Moderate†	35	28.2 ± 8.4	19	10.9 ± 5.3	54	30.9 ± 5.1	80	36.0 ± 5.8	188	24.0 ± 3.9
	High‡	28	23.0 ± 9.5	63	33.3 ± 10.0	34	19.9 ± 4.9	30	14.3 ± 4.3	155	24.8 ± 5.0
	Rural										
	Low*	12	46.2 ± 7.5	9	25.5 ± 18.7	14	40.0 ± 19.6	20	45.8 ± 25.6	55	38.3 ± 8.0
	Moderate†	3	7.7 ± 15.1	5	15.5 ± 17.5	8	22.0 ± 7.6	9	19.9 ± 13.7	25	13.9 ± 8.5
	High‡	12	46.2 ± 7.5	26	59.1 ± 36.1	15	38.0 ± 16.2	15	34.2 ± 16.4	68	47.8 ± 12.4
	Total										
	Low*	69	48.4 ± 9.4	100	50.6 ± 9.5	101	47.8 ± 6.4	131	49.1 ± 7.7	401	49.0 ± 5.0
	Moderate†	38	24.5 ± 7.4	24	11.7 ± 5.3	62	29.6 ± 4.5	89	33.4 ± 5.3	213	22.3 ± 3.5
	High‡	40	27.1 ± 7.9	89	37.7 ± 10.4	49	22.7 ± 4.8	45	17.5 ± 4.5	223	28.7 ± 4.6
Women	*Urban*										
	Low*	84	63.9 ± 8.8	120	57.9 ± 6.7	97	43.1 ± 6.8	96	40.3 ± 5.1	397	55.2 ± 4.2
	Moderate†	30	22.4 ± 6.2	63	31.2 ± 7.8	94	40.7 ± 6.3	107	46.8 ± 5.3	294	31.5 ± 3.6
	High‡	22	13.7 ± 5.6	23	10.9 ± 4.3	38	16.2 ± 4.5	30	12.9 ± 4.6	113	13.4 ± 2.7
	Rural										
	Low*	16	62.3 ± 10.2	17	43.1 ± 25.4	19	42.5 ± 7.5	27	47.5 ± 13.8	79	51.3 ± 8.6
	Moderate†	9	37.7 ± 10.2	13	39.2 ± 20.9	14	30.9 ± 10.5	18	36.7 ± 17.3	54	36.6 ± 7.8
	High‡	0	0.0 ± 0.0	6	17.6 ± 5.5	12	26.6 ± 6.6	9	15.9 ± 4.1	27	12.1 ± 2.1
	Total										
	Low*	100	63.6 ± 7.5	137	55.6 ± 6.9	116	43.0 ± 5.9	123	41.4 ± 4.8	476	54.6 ± 3.8
	Moderate†	39	25.0 ± 5.5	76	32.4 ± 7.3	108	39.2 ± 5.6	125	45.2 ± 5.2	348	32.3 ± 3.3
	High‡	22	11.4 ± 4.7	29	12.0 ± 3.7	50	17.8 ± 4.0	39	13.4 ± 4.0	140	13.2 ± 2.3

* Low: < 600 MET-minutes per week; † Moderate: 600-2999 MET-minutes per week; ‡ High: 3000+ MET-minutes per week

Table 6.5. Body mass index of participants in Ho Chi Minh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<18.5 kg/m2	13	11.5 ± 6.1	24	14.1 ± 6.3	14	8.6 ± 4.6	29	14.1 ± 5.4	80	11.9 ± 3.3
	18.5-22.9 kg/m2	58	47.3 ± 9.6	72	40.7 ± 10.5	72	42.3 ± 7.9	108	49.0 ± 9.1	310	44.3 ± 5.3
	23.0-24.9 kg/m2	21	16.1 ± 6.9	41	22.6 ± 8.3	44	23.8 ± 8.0	41	18.4 ± 5.3	147	20.0 ± 4.1
	25.0-29.9 kg/m2	24	22.0 ± 8.6	32	19.2 ± 6.8	39	21.6 ± 5.2	40	17.1 ± 5.8	135	20.6 ± 4.1
	30+ kg/m2	4	3.2 ± 3.0	5	3.4 ± 2.8	6	3.6 ± 2.5	3	1.4 ± 1.9	18	3.2 ± 1.6
	Rural										
	<18.5 kg/m2	2	8.1 ± 9.4	4	10.8 ± 12.1	7	20.2 ± 20.7	5	11.3 ± 4.2	18	11.5 ± 6.8
	18.5-22.9 kg/m2	13	47.1 ± 9.7	26	67.9 ± 22.2	14	35.5 ± 24.1	24	54.8 ± 4.7	77	52.1 ± 9.3
	23.0-24.9 kg/m2	7	24.1 ± 8.0	3	6.3 ± 6.7	11	29.1 ± 6.5	8	18.5 ± 10.0	29	18.9 ± 4.2
	25.0-29.9 kg/m2	5	20.6 ± 17.3	6	13.0 ± 12.9	5	15.2 ± 10.3	6	13.1 ± 14.2	22	16.6 ± 8.5
	30+ kg/m2	0	0.0 ± 0.0	1	2.0 ± 3.8	0	0.0 ± 0.0	1	2.4 ± 4.7	2	0.8 ± 1.3
	Total										
	<18.5 kg/m2	15	10.9 ± 5.3	28	13.6 ± 5.6	21	10.4 ± 5.0	34	13.7 ± 4.6	98	11.9 ± 2.9
	18.5-22.9 kg/m2	71	47.3 ± 8.1	98	45.3 ± 9.5	86	41.3 ± 7.6	132	49.9 ± 7.7	387	45.6 ± 4.7
	23.0-24.9 kg/m2	28	17.5 ± 5.8	44	19.8 ± 7.0	55	24.6 ± 6.8	49	18.4 ± 4.7	176	19.8 ± 3.5
	25.0-29.9 kg/m2	29	21.8 ± 7.7	38	18.1 ± 6.0	44	20.6 ± 4.7	46	16.5 ± 5.4	157	19.9 ± 3.7
	30+ kg/m2	4	2.6 ± 2.5	6	3.1 ± 2.4	6	3.1 ± 2.1	4	1.5 ± 1.8	20	2.8 ± 1.3
Women	*Urban*										
	<18.5 kg/m2	22	13.9 ± 6.0	20	10.2 ± 4.2	18	8.8 ± 5.1	14	6.1 ± 2.8	74	10.9 ± 2.9
	18.5-22.9 kg/m2	90	70.4 ± 8.2	115	55.6 ± 8.4	112	48.9 ± 5.5	106	47.1 ± 5.9	423	59.0 ± 4.2
	23.0-24.9 kg/m2	15	10.3 ± 5.3	43	21.1 ± 7.4	44	17.5 ± 5.2	55	22.5 ± 4.8	157	16.2 ± 3.2
	25.0-29.9 kg/m2	7	4.1 ± 3.2	26	11.2 ± 5.0	52	22.7 ± 6.9	54	22.8 ± 6.6	139	12.2 ± 2.5
	30+ kg/m2	2	1.3 ± 1.8	4	1.9 ± 2.1	5	2.1 ± 1.7	4	1.4 ± 1.3	15	1.7 ± 1.0
	Rural										
	<18.5 kg/m2	3	10.8 ± 10.8	4	7.8 ± 15.4	5	10.7 ± 10.9	8	16.2 ± 10.9	20	10.5 ± 6.7
	18.5-22.9 kg/m2	16	64.1 ± 8.1	25	70.8 ± 17.7	19	42.5 ± 12.5	19	33.9 ± 21.2	79	58.6 ± 6.9
	23.0-24.9 kg/m2	2	7.8 ± 8.2	5	10.9 ± 13.4	11	23.9 ± 13.7	14	24.8 ± 11.0	32	13.7 ± 5.9
	25.0-29.9 kg/m2	3	14.3 ± 16.2	3	10.4 ± 12.6	9	20.5 ± 14.9	11	19.3 ± 5.9	26	15.0 ± 8.1
	30+ kg/m2	1	3.0 ± 5.9	0	0.0 ± 0.0	1	2.4 ± 4.7	3	5.7 ± 7.8	5	2.3 ± 2.7

Total										
<18.5 kg/m2	25	13.4 ± 5.3	24	9.8 ± 4.3	23	9.1 ± 4.7	22	7.7 ± 2.9	94	10.8 ± 2.6
18.5-22.9 kg/m2	106	69.4 ± 7.0	140	58.0 ± 7.6	131	48.0 ± 5.0	125	45.0 ± 6.0	502	58.9 ± 3.7
23.0-24.9 kg/m2	17	9.9 ± 4.6	48	19.5 ± 6.5	55	18.4 ± 4.9	69	22.9 ± 4.4	189	15.8 ± 2.9
25.0-29.9 kg/m2	10	5.8 ± 3.8	29	11.1 ± 4.7	61	22.4 ± 6.3	65	22.3 ± 5.6	165	12.6 ± 2.5
30+ kg/m2	3	1.6 ± 1.8	4	1.6 ± 1.8	6	2.2 ± 1.6	7	2.1 ± 1.6	20	1.8 ± 0.9

Table 6.6. Blood pressure levels of participants in Ho Chi Minh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Normotensive	111	89.0 ± 6.5	144	84.4 ± 5.7	122	67.2 ± 6.9	139	62.9 ± 6.2	516	80.7 ± 3.5
	Hypertensive*	10	11.0 ± 6.5	30	15.6 ± 5.7	54	32.8 ± 6.9	82	37.1 ± 6.2	176	19.3 ± 3.5
	Rural										
	Normotensive	25	91.7 ± 16.3	33	83.3 ± 5.9	25	64.8 ± 17.0	25	56.0 ± 33.9	108	81.0 ± 8.1
	Hypertensive*	2	8.3 ± 16.3	7	16.7 ± 5.9	12	35.2 ± 17.0	19	44.0 ± 33.9	40	19.0 ± 8.1
	Total										
	Normotensive	136	89.5 ± 6.1	177	84.2 ± 4.8	147	66.8 ± 6.4	164	61.7 ± 7.5	624	80.7 ± 3.2
	Hypertensive*	12	10.5 ± 6.1	37	15.8 ± 4.8	66	33.2 ± 6.4	101	38.3 ± 7.5	216	19.3 ± 3.2
Women	*Urban*										
	Normotensive	132	97.5 ± 2.4	194	93.2 ± 4.2	183	79.2 ± 7.0	150	65.1 ± 6.0	659	88.9 ± 2.3
	Hypertensive*	4	2.5 ± 2.4	15	6.8 ± 4.2	48	20.8 ± 7.0	83	34.9 ± 6.0	150	11.1 ± 2.3
	Rural										
	Normotensive	25	100.0 ± 0.0	31	84.7 ± 15.0	38	84.5 ± 15.3	35	63.2 ± 3.2	129	88.8 ± 5.3
	Hypertensive*	0	0.0 ± 0.0	6	15.3 ± 15.0	7	15.5 ± 15.3	20	36.8 ± 3.2	33	11.2 ± 5.3
	Total										
	Normotensive	157	97.9 ± 2.0	225	91.9 ± 4.2	221	80.0 ± 6.4	185	64.8 ± 5.1	788	88.9 ± 2.1
	Hypertensive*	4	2.1 ± 2.0	21	8.1 ± 4.2	55	20.0 ± 6.4	103	35.2 ± 5.1	183	11.1 ± 2.1

* Systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or using hypertensive medications.

Table 6.7. Fasting blood glucose levels of participants in Ho Chi Minh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<5.6 mmol/L	113	98.0 ± 2.7	156	93.7 ± 3.9	156	93.1 ± 3.5	196	89.8 ± 4.6	621	94.9 ± 1.8
	5.6-6.1 mmol/L	0	0.0 ± 0.0	5	3.0 ± 2.5	4	2.6 ± 2.5	11	5.5 ± 2.9	20	2.0 ± 1.0
	6.1+ mmol/L	2	2.0 ± 2.7	4	3.2 ± 3.3	7	4.3 ± 3.3	10	4.8 ± 2.8	23	3.1 ± 1.7
	Rural										
	<5.6 mmol/L	25	97.2 ± 5.4	38	95.7 ± 4.3	33	93.5 ± 7.1	44	100.0 ± 0.0	140	96.2 ± 3.0
	5.6-6.1 mmol/L	1	2.8 ± 5.4	1	2.4 ± 4.7	1	4.2 ± 8.2	0	0.0 ± 0.0	3	2.7 ± 3.1
	6.1+ mmol/L	0	0.0 ± 0.0	1	2.0 ± 3.8	1	2.4 ± 4.7	0	0.0 ± 0.0	2	1.1 ± 1.5
	Total										
	<5.6 mmol/L	138	97.8 ± 2.5	194	94.1 ± 3.3	189	93.2 ± 3.1	240	91.4 ± 3.8	761	95.1 ± 1.6
	5.6-6.1 mmol/L	1	0.5 ± 1.0	6	2.9 ± 2.2	5	2.8 ± 2.4	11	4.6 ± 2.4	23	2.1 ± 1.0
	6.1+ mmol/L	2	1.7 ± 2.3	5	3.0 ± 2.8	8	4.0 ± 2.9	10	4.0 ± 2.4	25	2.8 ± 1.4
Women	*Urban*										
	<5.6 mmol/L	129	97.4 ± 2.9	196	97.5 ± 2.1	216	96.3 ± 2.6	209	91.0 ± 4.7	750	96.5 ± 1.5
	5.6-6.1 mmol/L	0	0.0 ± 0.0	2	0.8 ± 1.1	4	1.9 ± 1.7	7	3.4 ± 2.8	13	1.0 ± 0.6
	6.1+ mmol/L	3	2.6 ± 2.9	4	1.7 ± 1.9	4	1.8 ± 1.6	12	5.6 ± 3.1	23	2.5 ± 1.3
	Rural										
	<5.6 mmol/L	25	100.0 ± 0.0	35	96.1 ± 7.7	42	95.6 ± 4.4	45	90.6 ± 11.4	147	97.0 ± 2.6
	5.6-6.1 mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	1	3.3 ± 6.5	1	0.3 ± 0.7
	6.1+ mmol/L	0	0.0 ± 0.0	2	3.9 ± 7.7	2	4.4 ± 4.4	3	6.1 ± 6.1	7	2.6 ± 2.4
	Total										
	<5.6 mmol/L	154	97.8 ± 2.4	231	97.3 ± 2.1	258	96.2 ± 2.3	254	91.0 ± 4.4	897	96.6 ± 1.3
	5.6-6.1 mmol/L	0	0.0 ± 0.0	2	0.7 ± 0.9	4	1.6 ± 1.4	8	3.4 ± 2.6	14	0.9 ± 0.5
	6.1+ mmol/L	3	2.2 ± 2.4	6	2.1 ± 2.0	6	2.2 ± 1.5	15	5.7 ± 2.8	30	2.5 ± 1.2

Table 6.8. Fasting blood cholesterol levels of participants in Ho Chi Minh

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5.0 mmol/L	83	72.0 ± 8.3	92	54.7 ± 7.9	99	59.1 ± 8.4	113	52.2 ± 9.1	387	62.1 ± 4.5
	5.0-6.1 mmol/L	29	26.2 ± 8.0	57	36.3 ± 6.0	52	31.0 ± 7.6	76	35.6 ± 7.5	214	31.2 ± 4.0
	6.2+ mmol/L	2	1.8 ± 2.5	15	9.0 ± 4.1	16	10.0 ± 5.0	26	12.2 ± 4.3	59	6.7 ± 2.0
	Rural										
	< 5.0 mmol/L	19	75.0 ± 28.3	35	86.3 ± 8.7	24	71.2 ± 3.8	29	66.1 ± 12.6	107	77.2 ± 12.0
	5.0-6.1 mmol/L	5	16.7 ± 16.3	5	13.7 ± 8.7	5	14.4 ± 8.9	10	22.9 ± 5.7	25	15.8 ± 7.5
	6.2+ mmol/L	2	8.3 ± 16.3	0	0.0 ± 0.0	5	14.4 ± 8.9	5	11.0 ± 11.1	12	7.0 ± 7.0
	Total										
	< 5.0 mmol/L	102	72.5 ± 8.5	127	60.1 ± 6.7	123	60.9 ± 7.1	142	54.5 ± 7.9	494	64.7 ± 4.3
	5.0-6.1 mmol/L	34	24.5 ± 7.2	62	32.4 ± 5.2	57	28.4 ± 6.6	86	33.6 ± 6.3	239	28.6 ± 3.6
	6.2+ mmol/L	4	3.0 ± 3.5	15	7.5 ± 3.4	21	10.7 ± 4.4	31	12.0 ± 4.0	71	6.8 ± 2.0
Women	*Urban*										
	< 5.0 mmol/L	102	74.5 ± 8.0	126	57.4 ± 9.7	102	44.4 ± 7.1	68	28.4 ± 6.1	398	58.2 ± 4.5
	5.0-6.1 mmol/L	27	23.8 ± 7.9	63	36.8 ± 10.2	85	38.6 ± 6.8	106	47.4 ± 7.7	281	33.2 ± 4.6
	6.2+ mmol/L	3	1.8 ± 1.9	13	5.7 ± 3.6	37	17.0 ± 3.9	54	24.2 ± 5.1	107	8.6 ± 1.6
	Rural										
	< 5.0 mmol/L	20	77.9 ± 12.7	24	67.8 ± 14.9	21	47.8 ± 7.9	21	38.6 ± 29.2	86	64.9 ± 7.5
	5.0-6.1 mmol/L	5	22.1 ± 12.7	11	25.5 ± 21.6	16	36.2 ± 7.5	24	53.9 ± 25.6	56	29.1 ± 8.6
	6.2+ mmol/L	0	0.0 ± 0.0	2	6.7 ± 6.7	7	16.0 ± 9.2	4	7.5 ± 7.5	13	6.0 ± 2.8
	Total										
	< 5.0 mmol/L	122	75.0 ± 7.0	150	59.1 ± 8.5	123	44.9 ± 6.2	89	30.0 ± 6.9	484	59.3 ± 4.0
	5.0-6.1 mmol/L	32	23.5 ± 6.9	74	35.0 ± 9.2	101	38.2 ± 5.9	130	48.4 ± 7.6	337	32.6 ± 4.1
	6.2+ mmol/L	3	1.5 ± 1.6	15	5.9 ± 3.2	44	16.9 ± 3.6	58	21.6 ± 4.5	120	8.2 ± 1.4

Table 7.1. Smoking status of participants in Can Tho

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Never	25	45.5 ± 12.2	16	24.6 ± 10.9	12	13.7 ± 10.5	20	27.4 ± 14.4	73	30.4 ± 6.3
	Ex-smoker	4	8.7 ± 7.1	11	17.0 ± 11.3	16	15.8 ± 11.2	12	15.8 ± 11.2	43	13.5 ± 5.1
	Current non-daily	0	0.0 ± 0.0	2	2.5 ± 3.2	2	3.4 ± 5.0	1	1.0 ± 2.0	5	1.6 ± 1.5
	Current daily	29	45.7 ± 14.3	37	56.0 ± 10.6	51	67.1 ± 16.3	39	55.8 ± 24.0	156	54.5 ± 7.6
	Rural										
	Never	39	37.9 ± 10.8	24	15.6 ± 10.1	32	27.7 ± 13.4	34	20.2 ± 11.4	129	27.0 ± 5.9
	Ex-smoker	10	7.8 ± 5.5	15	10.8 ± 5.4	15	13.5 ± 8.3	20	13.4 ± 7.3	60	10.4 ± 3.2
	Current non-daily	0	0.0 ± 0.0	1	1.2 ± 2.3	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.4 ± 0.7
	Current daily	49	54.3 ± 12.0	92	72.4 ± 9.8	65	58.8 ± 13.2	94	66.4 ± 13.6	300	62.2 ± 6.3
	Total										
	Never	64	42.9 ± 8.8	40	21.5 ± 8.0	44	18.1 ± 8.3	54	24.8 ± 10.2	202	29.2 ± 4.6
	Ex-smoker	14	8.4 ± 5.0	26	14.9 ± 7.7	31	15.1 ± 8.1	32	14.9 ± 7.7	103	12.5 ± 3.6
	Current non-daily	0	0.0 ± 0.0	3	2.1 ± 2.3	2	2.3 ± 3.4	1	0.7 ± 1.3	6	1.2 ± 1.0
	Current daily	78	48.7 ± 10.3	129	61.6 ± 7.7	116	64.5 ± 11.9	133	59.5 ± 16.3	456	57.1 ± 5.5
Women	*Urban*										
	Never	81	100.0 ± 0.0	88	97.5 ± 2.5	118	99.3 ± 1.3	84	92.8 ± 3.5	371	98.2 ± 0.9
	Ex-smoker	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.7 ± 1.3	1	1.4 ± 2.7	2	0.3 ± 0.4
	Current daily	0	0.0 ± 0.0	3	2.5 ± 2.5	0	0.0 ± 0.0	6	5.8 ± 3.7	9	1.4 ± 0.9
	Rural										
	Never	117	99.3 ± 1.4	137	99.0 ± 2.0	166	98.6 ± 2.0	139	98.9 ± 1.4	559	99.0 ± 0.9
	Ex-smoker	1	0.7 ± 1.4	1	1.0 ± 2.0	0	0.0 ± 0.0	0	0.0 ± 0.0	2	0.6 ± 0.8
	Current daily	0	0.0 ± 0.0	0	0.0 ± 0.0	2	1.4 ± 2.0	2	1.1 ± 1.4	4	0.5 ± 0.5
	Total										
	Never	198	99.8 ± 0.4	225	98.0 ± 1.8	284	99.1 ± 1.1	223	94.8 ± 2.4	930	98.5 ± 0.7
	Ex-smoker	1	0.2 ± 0.4	1	0.3 ± 0.7	1	0.5 ± 0.9	1	0.9 ± 1.8	4	0.4 ± 0.4
	Current daily	0	0.0 ± 0.0	3	1.7 ± 1.7	2	0.5 ± 0.6	8	4.2 ± 2.5	13	1.1 ± 0.6

Table 7.2. Alcohol consumption of participants in Can Tho

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Ever consume alc.	50	87.1 ± 10.4	50	78.8 ± 9.5	72	90.1 ± 6.5	56	78.7 ± 11.3	228	84.3 ± 5.2
	Consumed last 12ms	49	85.5 ± 9.7	47	73.6 ± 8.1	68	83.6 ± 5.0	46	65.5 ± 9.8	210	79.4 ± 4.7
	Hazardous drinking*	12	22.1 ± 10.6	16	25.7 ± 10.0	9	10.8 ± 6.2	10	15.3 ± 13.2	47	20.2 ± 5.4
	Harmful drinking†	18	31.4 ± 13.7	14	19.6 ± 10.0	29	34.7 ± 13.9	16	21.4 ± 15.3	77	27.4 ± 6.9
	Rural										
	Ever consume alc.	78	76.1 ± 16.2	114	85.1 ± 7.3	87	81.8 ± 9.4	107	74.5 ± 8.6	386	79.9 ± 6.9
	Consumed last 12ms	74	72.6 ± 16.3	108	80.5 ± 8.8	80	76.1 ± 10.2	86	60.1 ± 10.3	348	74.5 ± 7.2
	Hazardous drinking*	11	11.7 ± 4.8	17	13.9 ± 5.5	6	6.9 ± 5.3	18	12.9 ± 5.1	52	11.6 ± 2.8
	Harmful drinking†	47	47.5 ± 11.2	61	45.9 ± 9.5	53	49.4 ± 9.1	41	28.6 ± 8.5	202	45.3 ± 5.6
	Total										
	Ever consume alc.	128	83.3 ± 8.8	164	80.9 ± 6.8	159	87.5 ± 5.3	163	77.3 ± 7.9	614	82.8 ± 4.2
	Consumed last 12ms	123	81.1 ± 8.5	155	76.0 ± 6.1	148	81.3 ± 4.7	132	63.6 ± 7.3	558	77.7 ± 3.9
	Hazardous drinking*	23	18.5 ± 7.1	33	21.7 ± 6.9	15	9.6 ± 4.6	28	14.5 ± 8.8	99	17.3 ± 3.7
	Harmful drinking†	65	36.9 ± 9.8	75	28.5 ± 7.3	82	39.3 ± 9.9	57	23.9 ± 10.4	279	33.4 ± 4.9
Women	*Urban*										
	Ever consume alc.	15	18.7 ± 10.5	6	7.5 ± 10.3	12	9.8 ± 6.6	8	7.9 ± 5.6	41	12.0 ± 5.1
	Consumed last 12ms	14	17.5 ± 10.0	5	6.8 ± 10.3	9	7.0 ± 6.7	4	3.3 ± 4.2	32	10.1 ± 4.9
	Hazardous drinking*	4	4.5 ± 3.4	1	1.8 ± 3.5	5	3.4 ± 4.4	0	0.0 ± 0.0	10	2.9 ± 1.9
	Harmful drinking†	2	2.8 ± 3.6	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.9 ± 1.7	3	1.1 ± 1.3
	Rural										
	Ever consume alc.	4	3.0 ± 2.5	1	1.0 ± 2.0	0	0.0 ± 0.0	2	1.2 ± 1.7	7	1.5 ± 1.1
	Consumed last 12ms	3	2.3 ± 2.4	1	1.0 ± 2.0	0	0.0 ± 0.0	1	0.8 ± 1.5	5	1.2 ± 1.0
	Hazardous drinking*	2	1.6 ± 2.1	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	2	0.6 ± 0.7
	Harmful drinking†	1	0.7 ± 1.4	1	1.0 ± 2.0	0	0.0 ± 0.0	0	0.0 ± 0.0	2	0.6 ± 0.8
	Total										
	Ever consume alc.	19	13.6 ± 7.1	7	5.4 ± 7.0	12	6.7 ± 4.6	10	5.7 ± 3.8	48	8.6 ± 3.4
	Consumed last 12ms	17	12.5 ± 6.8	6	5.0 ± 7.0	9	4.8 ± 4.6	5	2.4 ± 2.9	37	7.3 ± 3.3
	Hazardous drinking*	6	3.5 ± 2.4	1	1.2 ± 2.4	5	2.3 ± 3.0	0	0.0 ± 0.0	12	2.1 ± 1.3
	Harmful drinking†	3	2.1 ± 2.5	1	0.3 ± 0.7	0	0.0 ± 0.0	1	0.6 ± 1.2	5	0.9 ± 0.9

* Hazardous drinking: ≥4 standard drinks (men), ≥2 standard drinks (women); † Harmful drinking: ≥6 standard drinks (men), ≥4 standard drinks (women).

Table 7.3. Servings of fruit and vegetable in Can Tho

		25–34			35–44			45–54			55–64			Total		
		n	Mean 95%CI		n	Mean 95%CI		n	Mean 95%CI		n	Mean 95%CI		n	Mean 95%CI	
Men	*Urban*															
	< 5 servings/day	49	89.5 ± 8.7		47	70.3 ± 12.0		73	93.3 ± 7.4		58	84.0 ± 9.3		227	83.7 ± 5.3	
	≥ 5 servings/day	7	10.5 ± 8.7		18	29.7 ± 12.0		6	6.7 ± 7.4		11	16.0 ± 9.3		42	16.3 ± 5.3	
	Rural															
	< 5 servings/day	79	84.4 ± 11.0		108	88.6 ± 9.7		90	85.6 ± 7.9		119	89.6 ± 5.7		396	86.5 ± 5.5	
	≥ 5 servings/day	13	15.6 ± 11.0		13	11.4 ± 9.7		17	14.4 ± 7.9		16	10.4 ± 5.7		59	13.5 ± 5.5	
	Total															
	< 5 servings/day	128	87.7 ± 6.9		155	76.5 ± 8.6		163	90.9 ± 5.7		177	86.0 ± 6.3		623	84.7 ± 4.0	
	≥ 5 servings/day	20	12.3 ± 6.9		31	23.5 ± 8.6		23	9.1 ± 5.7		27	14.0 ± 6.3		101	15.3 ± 4.0	
Women	*Urban*															
	< 5 servings/day	70	86.4 ± 6.7		78	86.7 ± 5.1		101	88.1 ± 8.3		78	86.5 ± 7.8		327	86.9 ± 3.5	
	≥ 5 servings/day	11	13.6 ± 6.7		13	13.3 ± 5.1		14	11.9 ± 8.3		13	13.5 ± 7.8		51	13.1 ± 3.5	
	Rural															
	< 5 servings/day	100	90.7 ± 5.0		114	89.4 ± 5.4		148	92.1 ± 3.5		116	91.0 ± 5.0		478	90.7 ± 2.6	
	≥ 5 servings/day	11	9.3 ± 5.0		15	10.6 ± 5.4		12	7.9 ± 3.5		13	9.0 ± 5.0		51	9.3 ± 2.6	
	Total															
	< 5 servings/day	170	87.8 ± 4.8		192	87.6 ± 3.9		249	89.4 ± 5.8		194	88.0 ± 5.5		805	88.1 ± 2.5	
	≥ 5 servings/day	22	12.2 ± 4.8		28	12.4 ± 3.9		26	10.6 ± 5.8		26	12.0 ± 5.5		102	11.9 ± 2.5	

Table 7.4. Physical activity levels of participants in Can Tho

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Low*	16	29.7 ± 8.4	21	33.6 ± 9.7	25	34.7 ± 11.2	21	24.7 ± 10.4	83	31.5 ± 5.1
	Moderate†	15	27.5 ± 13.1	22	35.1 ± 14.1	28	30.4 ± 16.5	35	54.5 ± 12.6	100	33.2 ± 7.6
	High‡	24	42.8 ± 13.4	21	31.3 ± 9.5	28	34.9 ± 11.8	16	20.8 ± 7.0	89	35.3 ± 6.4
	Rural										
	Low*	30	32.8 ± 8.9	30	21.6 ± 8.4	36	33.2 ± 10.5	46	30.9 ± 7.4	142	29.1 ± 4.9
	Moderate†	32	32.9 ± 11.7	30	22.5 ± 4.6	35	32.2 ± 9.0	54	37.9 ± 10.8	151	30.0 ± 5.2
	High‡	35	34.3 ± 12.8	71	56.0 ± 8.3	40	34.6 ± 13.1	46	31.1 ± 9.6	192	40.9 ± 6.2
	Total										
	Low*	46	30.8 ± 6.3	51	29.5 ± 7.0	61	34.2 ± 8.4	67	26.9 ± 7.3	225	30.7 ± 3.8
	Moderate†	47	29.4 ± 9.5	52	30.8 ± 9.4	63	31.0 ± 11.7	89	48.7 ± 9.0	251	32.1 ± 5.3
	High‡	59	39.9 ± 9.8	92	39.7 ± 6.9	68	34.8 ± 9.1	62	24.4 ± 5.6	281	37.2 ± 4.7
Women	*Urban*										
	Low*	31	37.2 ± 8.8	33	33.7 ± 11.6	42	36.2 ± 6.6	28	32.5 ± 7.7	134	35.4 ± 5.0
	Moderate†	27	33.9 ± 7.7	34	38.4 ± 11.4	51	42.6 ± 6.0	43	44.5 ± 11.6	155	38.6 ± 4.8
	High‡	23	28.8 ± 6.7	24	27.9 ± 13.9	25	21.2 ± 4.8	19	23.0 ± 11.8	91	26.0 ± 5.1
	Rural										
	Low*	62	52.4 ± 13.0	51	37.2 ± 5.8	45	26.4 ± 8.0	68	49.2 ± 8.4	226	41.6 ± 5.3
	Moderate†	32	27.1 ± 10.3	42	30.2 ± 6.7	79	47.0 ± 8.3	51	36.1 ± 7.5	204	33.6 ± 4.6
	High‡	24	20.5 ± 5.6	45	32.6 ± 7.6	42	26.6 ± 9.8	19	14.8 ± 6.4	130	24.8 ± 3.8
	Total										
	Low*	93	42.2 ± 7.3	84	34.9 ± 8.1	87	33.1 ± 5.2	96	38.0 ± 5.9	360	37.4 ± 3.8
	Moderate†	59	31.7 ± 6.2	76	35.8 ± 8.0	130	44.0 ± 4.8	94	41.7 ± 8.1	359	37.0 ± 3.5
	High‡	47	26.1 ± 4.9	69	29.4 ± 9.7	67	22.9 ± 4.5	38	20.3 ± 8.2	221	25.6 ± 3.6

* Low: < 600 MET-minutes per week; † Moderate: 600-2999 MET-minutes per week; ‡ High: 3000+ MET-minutes per week

Table 7.5. Body mass index of participants in Can Tho

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<18.5 kg/m2	8	11.2 ± 10.3	10	12.4 ± 9.2	8	11.4 ± 9.3	12	16.7 ± 10.3	38	12.2 ± 5.3
	18.5-22.9 kg/m2	36	66.0 ± 11.7	34	50.5 ± 15.9	39	47.4 ± 11.1	42	62.3 ± 12.5	151	56.8 ± 7.1
	23.0-24.9 kg/m2	7	11.6 ± 7.8	11	17.6 ± 11.2	20	24.7 ± 8.5	7	8.2 ± 5.3	45	15.9 ± 4.9
	25.0-29.9 kg/m2	7	11.2 ± 5.2	11	19.5 ± 9.9	12	14.0 ± 5.1	10	12.8 ± 9.9	40	14.5 ± 3.9
	30+ kg/m2	0	0.0 ± 0.0	0	0.0 ± 0.0	2	2.5 ± 3.3	0	0.0 ± 0.0	2	0.5 ± 0.7
	Rural										
	<18.5 kg/m2	20	22.4 ± 11.6	12	9.5 ± 5.7	19	18.5 ± 9.1	30	20.3 ± 5.3	81	17.4 ± 5.1
	18.5-22.9 kg/m2	55	56.9 ± 14.4	86	65.7 ± 9.0	65	56.3 ± 9.7	85	58.4 ± 8.7	291	59.7 ± 6.5
	23.0-24.9 kg/m2	8	8.0 ± 4.4	19	13.9 ± 7.6	17	15.1 ± 4.2	19	12.4 ± 4.1	63	11.7 ± 3.1
	25.0-29.9 kg/m2	11	9.8 ± 6.9	15	10.8 ± 4.0	9	8.3 ± 6.2	13	8.4 ± 6.7	48	9.7 ± 3.2
	30+ kg/m2	4	2.9 ± 3.8	0	0.0 ± 0.0	2	1.9 ± 2.5	1	0.5 ± 1.0	7	1.5 ± 1.6
	Total										
	<18.5 kg/m2	28	15.0 ± 7.8	22	11.4 ± 6.4	27	13.6 ± 7.0	42	18.0 ± 6.9	119	13.9 ± 3.9
	18.5-22.9 kg/m2	91	62.9 ± 9.1	120	55.7 ± 10.9	104	50.2 ± 8.2	127	60.9 ± 8.6	442	57.8 ± 5.2
	23.0-24.9 kg/m2	15	10.4 ± 5.3	30	16.3 ± 7.8	37	21.7 ± 6.0	26	9.7 ± 3.7	108	14.5 ± 3.4
	25.0-29.9 kg/m2	18	10.7 ± 4.1	26	16.5 ± 6.6	21	12.2 ± 4.0	23	11.3 ± 6.8	88	12.9 ± 2.8
	30+ kg/m2	4	1.0 ± 1.3	0	0.0 ± 0.0	4	2.3 ± 2.4	1	0.2 ± 0.4	9	0.9 ± 0.7
Women	*Urban*										
	<18.5 kg/m2	15	19.1 ± 7.3	7	8.7 ± 6.3	9	7.3 ± 5.5	9	8.5 ± 4.6	40	12.0 ± 3.4
	18.5-22.9 kg/m2	48	57.8 ± 12.6	42	47.8 ± 11.5	44	36.5 ± 8.9	40	45.7 ± 12.8	174	48.4 ± 6.1
	23.0-24.9 kg/m2	8	9.6 ± 10.5	21	23.3 ± 7.4	24	20.9 ± 7.0	21	20.6 ± 9.3	74	17.7 ± 4.7
	25.0-29.9 kg/m2	8	10.7 ± 5.4	18	17.8 ± 10.1	39	33.1 ± 7.4	20	24.3 ± 8.5	85	19.7 ± 4.1
	30+ kg/m2	2	2.8 ± 3.6	3	2.4 ± 3.2	3	2.2 ± 2.1	1	0.9 ± 1.7	9	2.3 ± 1.7
	Rural										
	<18.5 kg/m2	20	17.1 ± 6.1	7	5.1 ± 2.8	22	14.4 ± 9.4	18	12.9 ± 7.2	67	12.4 ± 3.3
	18.5-22.9 kg/m2	75	62.4 ± 7.4	78	57.7 ± 7.2	75	45.0 ± 6.2	54	38.5 ± 7.6	282	54.1 ± 3.8
	23.0-24.9 kg/m2	15	13.4 ± 6.5	31	21.4 ± 9.1	31	18.2 ± 5.8	34	24.3 ± 8.2	111	18.2 ± 3.9
	25.0-29.9 kg/m2	6	5.7 ± 4.9	19	13.8 ± 5.8	38	21.3 ± 7.4	31	21.6 ± 7.5	94	13.6 ± 3.1
	30+ kg/m2	2	1.4 ± 1.8	3	2.0 ± 2.1	2	1.0 ± 1.4	4	2.7 ± 2.3	11	1.6 ± 1.0

Total										
<18.5 kg/m2	35	18.4 ± 5.3	14	7.6 ± 4.3	31	9.5 ± 4.8	27	10.0 ± 3.9	107	12.1 ± 2.6
18.5-22.9 kg/m2	123	59.3 ± 8.8	120	51.0 ± 8.1	119	39.2 ± 6.4	94	43.3 ± 8.9	456	50.2 ± 4.3
23.0-24.9 kg/m2	23	10.8 ± 7.4	52	22.7 ± 5.8	55	20.1 ± 5.1	55	21.8 ± 6.8	185	17.8 ± 3.4
25.0-29.9 kg/m2	14	9.1 ± 4.0	37	16.5 ± 7.1	77	29.4 ± 5.6	51	23.4 ± 6.2	179	17.7 ± 2.9
30+ kg/m2	4	2.3 ± 2.5	6	2.3 ± 2.2	5	1.8 ± 1.5	5	1.5 ± 1.4	20	2.1 ± 1.2

Table 7.6. Blood pressure levels of participants in Can Tho

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Normotensive	54	94.1 ± 6.2	55	85.0 ± 8.0	54	68.3 ± 14.3	38	54.2 ± 13.6	201	81.8 ± 4.8
	Hypertensive*	4	5.9 ± 6.2	11	15.0 ± 8.0	27	31.7 ± 14.3	34	45.8 ± 13.6	76	18.2 ± 4.8
	Rural										
	Normotensive	85	88.4 ± 5.3	113	86.5 ± 4.8	79	69.6 ± 10.1	76	50.3 ± 5.8	353	80.1 ± 3.2
	Hypertensive*	13	11.6 ± 5.3	19	13.5 ± 4.8	33	30.4 ± 10.1	72	49.7 ± 5.8	137	19.9 ± 3.2
	Total										
	Normotensive	139	92.1 ± 4.5	168	85.5 ± 5.5	133	68.7 ± 10.3	114	52.8 ± 9.0	554	81.2 ± 3.3
	Hypertensive*	17	7.9 ± 4.5	30	14.5 ± 5.5	60	31.3 ± 10.3	106	47.2 ± 9.0	213	18.8 ± 3.3
Women	*Urban*										
	Normotensive	79	97.0 ± 3.8	80	87.2 ± 6.2	79	65.5 ± 8.0	53	60.0 ± 12.4	291	82.3 ± 3.3
	Hypertensive*	2	3.0 ± 3.8	11	12.8 ± 6.2	40	34.5 ± 8.0	38	40.0 ± 12.4	91	17.7 ± 3.3
	Rural										
	Normotensive	112	94.6 ± 4.2	124	90.5 ± 3.9	124	74.2 ± 5.6	90	63.6 ± 7.9	450	85.0 ± 2.5
	Hypertensive*	6	5.4 ± 4.2	14	9.5 ± 3.9	44	25.8 ± 5.6	51	36.4 ± 7.9	115	15.0 ± 2.5
	Total										
	Normotensive	191	96.3 ± 2.9	204	88.3 ± 4.4	203	68.3 ± 5.8	143	61.2 ± 8.7	741	83.1 ± 2.4
	Hypertensive*	8	3.7 ± 2.9	25	11.7 ± 4.4	84	31.7 ± 5.8	89	38.8 ± 8.7	206	16.9 ± 2.4

* Systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or using hypertensive medications.

Table 7.7. Fasting blood glucose levels of participants in Can Tho

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<5.6 mmol/L	43	97.9 ± 4.1	54	97.9 ± 4.1	59	89.2 ± 9.8	57	88.5 ± 10.0	213	95.1 ± 3.0
	5.6-6.1 mmol/L	0	0.0 ± 0.0	1	2.1 ± 4.1	3	4.6 ± 5.9	1	1.8 ± 3.5	5	1.8 ± 1.8
	6.1+ mmol/L	1	2.1 ± 4.1	0	0.0 ± 0.0	5	6.2 ± 6.0	7	9.7 ± 8.8	13	3.1 ± 2.2
	Rural										
	<5.6 mmol/L	73	96.1 ± 4.5	99	96.2 ± 4.0	95	95.2 ± 4.8	120	93.3 ± 4.9	387	95.7 ± 2.4
	5.6-6.1 mmol/L	1	1.0 ± 2.0	1	1.0 ± 2.0	0	0.0 ± 0.0	2	1.9 ± 2.5	4	0.9 ± 1.1
	6.1+ mmol/L	2	2.8 ± 4.2	3	2.7 ± 3.7	6	4.8 ± 4.8	6	4.8 ± 4.3	17	3.4 ± 2.2
	Total										
	<5.6 mmol/L	116	97.3 ± 3.1	153	97.4 ± 3.0	154	91.1 ± 6.9	177	90.2 ± 6.7	600	95.3 ± 2.2
	5.6-6.1 mmol/L	1	0.4 ± 0.7	2	1.7 ± 2.8	3	3.1 ± 4.1	3	1.8 ± 2.4	9	1.5 ± 1.3
	6.1+ mmol/L	3	2.3 ± 3.0	3	0.9 ± 1.3	11	5.8 ± 4.4	13	8.0 ± 5.9	30	3.2 ± 1.6
Women	*Urban*										
	<5.6 mmol/L	58	98.7 ± 2.5	73	98.6 ± 2.7	90	95.5 ± 3.4	71	85.5 ± 5.9	292	96.4 ± 1.6
	5.6-6.1 mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	2	1.4 ± 2.7	3	2.3 ± 3.1	5	0.6 ± 0.7
	6.1+ mmol/L	1	1.3 ± 2.5	1	1.4 ± 2.7	3	3.1 ± 3.0	10	12.2 ± 7.1	15	3.0 ± 1.6
	Rural										
	<5.6 mmol/L	98	97.9 ± 3.0	118	99.2 ± 1.5	141	93.9 ± 3.7	110	90.1 ± 4.1	467	96.4 ± 1.5
	5.6-6.1 mmol/L	2	2.1 ± 3.0	1	0.8 ± 1.5	3	1.9 ± 2.6	1	0.8 ± 1.5	7	1.5 ± 1.3
	6.1+ mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	5	4.2 ± 3.6	10	9.1 ± 4.4	15	2.1 ± 1.0
	Total										
	<5.6 mmol/L	156	98.5 ± 1.9	191	98.8 ± 1.9	231	95.0 ± 2.6	181	87.0 ± 4.2	759	96.4 ± 1.2
	5.6-6.1 mmol/L	2	0.7 ± 1.0	1	0.2 ± 0.5	5	1.6 ± 2.0	4	1.8 ± 2.1	12	0.9 ± 0.7
	6.1+ mmol/L	1	0.8 ± 1.7	1	0.9 ± 1.8	8	3.4 ± 2.4	20	11.2 ± 4.9	30	2.7 ± 1.1

Table 7.8. Fasting blood cholesterol levels of participants in Can Tho

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5.0 mmol/L	32	71.8 ± 9.4	34	57.0 ± 25.9	27	39.7 ± 13.4	30	47.2 ± 13.6	123	57.9 ± 9.4
	5.0-6.1 mmol/L	10	23.6 ± 8.9	13	26.7 ± 19.8	32	48.6 ± 11.5	25	37.9 ± 8.3	80	31.3 ± 7.5
	6.2+ mmol/L	2	4.6 ± 5.9	8	16.3 ± 11.9	8	11.7 ± 6.9	10	14.9 ± 6.0	28	10.8 ± 4.6
	Rural										
	< 5.0 mmol/L	58	76.8 ± 11.3	63	62.7 ± 10.1	64	60.6 ± 14.0	70	54.8 ± 7.5	255	66.9 ± 6.1
	5.0-6.1 mmol/L	17	21.5 ± 10.9	34	31.8 ± 9.4	29	29.5 ± 11.0	46	35.7 ± 7.7	126	27.8 ± 5.6
	6.2+ mmol/L	1	1.7 ± 3.3	6	5.5 ± 4.5	8	9.9 ± 6.4	12	9.6 ± 4.2	27	5.3 ± 2.3
	Total										
	< 5.0 mmol/L	90	73.6 ± 7.3	97	58.9 ± 17.4	91	46.3 ± 10.2	100	49.9 ± 9.2	378	60.9 ± 6.5
	5.0-6.1 mmol/L	27	22.9 ± 6.9	47	28.4 ± 13.5	61	42.6 ± 8.6	71	37.1 ± 6.0	206	30.1 ± 5.3
	6.2+ mmol/L	3	3.6 ± 4.0	14	12.6 ± 8.0	16	11.1 ± 5.1	22	13.0 ± 4.2	55	9.0 ± 3.2
Women	*Urban*										
	< 5.0 mmol/L	45	76.1 ± 14.1	39	50.3 ± 17.8	39	40.4 ± 6.3	29	36.4 ± 9.0	152	55.3 ± 7.4
	5.0-6.1 mmol/L	12	19.3 ± 16.1	28	41.3 ± 12.2	37	40.5 ± 9.6	33	38.6 ± 13.8	110	33.1 ± 7.2
	6.2+ mmol/L	2	4.6 ± 5.9	6	8.4 ± 6.8	18	19.1 ± 7.9	22	25.1 ± 13.1	48	11.6 ± 3.8
	Rural										
	< 5.0 mmol/L	71	70.4 ± 9.2	70	60.3 ± 10.1	62	41.2 ± 6.6	48	38.7 ± 9.1	251	56.8 ± 4.8
	5.0-6.1 mmol/L	27	27.6 ± 7.3	41	31.8 ± 11.5	69	45.6 ± 6.7	53	44.8 ± 10.3	190	35.0 ± 4.7
	6.2+ mmol/L	2	2.1 ± 4.1	8	7.9 ± 4.4	18	13.2 ± 5.5	20	16.6 ± 10.5	48	8.1 ± 2.7
	Total										
	< 5.0 mmol/L	116	74.2 ± 9.9	109	53.5 ± 12.5	101	40.6 ± 4.8	77	37.1 ± 6.7	403	55.8 ± 5.3
	5.0-6.1 mmol/L	39	22.0 ± 11.1	69	38.3 ± 9.1	106	42.1 ± 6.9	86	40.6 ± 9.9	300	33.7 ± 5.1
	6.2+ mmol/L	4	3.8 ± 4.2	14	8.2 ± 4.8	36	17.3 ± 5.7	42	22.3 ± 9.4	96	10.5 ± 2.7

Table 8.1. Smoking status of participants in Dak Lak

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Never	5	16.1 ± 11.6	7	18.9 ± 7.5	7	19.0 ± 17.0	7	14.0 ± 3.3	26	17.5 ± 6.2
	Ex-smoker	7	32.1 ± 15.5	11	28.9 ± 10.8	14	40.0 ± 29.6	14	27.7 ± 13.0	46	32.6 ± 9.7
	Current non-daily	1	12.5 ± 24.5	0	0.0 ± 0.0	0	0.0 ± 0.0	2	3.5 ± 3.9	3	4.5 ± 8.2
	Current daily	12	39.3 ± 27.7	19	52.2 ± 8.5	15	41.0 ± 20.8	27	54.8 ± 11.8	73	45.4 ± 11.0
	Rural										
	Never	71	41.9 ± 13.4	47	25.9 ± 10.4	37	17.8 ± 10.2	27	18.6 ± 13.8	182	29.3 ± 6.5
	Ex-smoker	22	15.9 ± 4.4	43	29.5 ± 4.5	65	38.9 ± 18.7	62	34.3 ± 13.6	192	27.0 ± 4.7
	Current non-daily	4	2.9 ± 4.4	4	2.0 ± 3.0	3	2.0 ± 3.5	3	3.7 ± 4.3	14	2.5 ± 2.1
	Current daily	62	39.3 ± 15.4	92	42.6 ± 12.0	90	41.3 ± 12.9	89	43.4 ± 17.9	333	41.2 ± 7.6
	Total										
	Never	76	36.7 ± 11.0	54	24.4 ± 8.3	44	18.1 ± 8.8	34	17.6 ± 10.7	208	26.8 ± 5.3
	Ex-smoker	29	19.1 ± 4.7	54	29.4 ± 4.2	79	39.1 ± 15.9	76	32.8 ± 10.9	238	28.2 ± 4.3
	Current non-daily	5	4.9 ± 6.1	4	1.5 ± 2.4	3	1.5 ± 2.7	5	3.7 ± 3.4	17	2.9 ± 2.4
	Current daily	74	39.3 ± 13.5	111	44.6 ± 9.6	105	41.2 ± 11.0	116	46.0 ± 14.1	406	42.1 ± 6.4
Women	*Urban*										
	Never	39	97.9 ± 4.1	42	100.0 ± 0.0	47	97.9 ± 4.1	33	97.2 ± 5.4	161	98.5 ± 1.8
	Ex-smoker	1	2.1 ± 4.1	0	0.0 ± 0.0	1	2.1 ± 4.1	1	2.8 ± 5.4	3	1.5 ± 1.8
	Current daily	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0
	Rural										
	Never	180	96.7 ± 3.6	175	99.5 ± 0.6	224	97.2 ± 3.1	161	89.0 ± 13.0	740	96.9 ± 2.0
	Ex-smoker	1	1.6 ± 3.2	2	0.3 ± 0.5	4	1.9 ± 3.0	7	6.1 ± 11.0	14	1.7 ± 1.7
	Current non-daily	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.1 ± 0.2	0	0.0 ± 0.0	1	0.0 ± 0.1
	Current daily	2	1.6 ± 3.0	1	0.2 ± 0.4	6	0.7 ± 0.6	9	4.9 ± 4.7	18	1.3 ± 1.2
	Total										
	Never	219	97.0 ± 3.0	217	99.6 ± 0.5	271	97.4 ± 2.6	194	90.7 ± 10.3	901	97.3 ± 1.6
	Ex-smoker	1	1.3 ± 2.5	2	0.3 ± 0.4	4	1.5 ± 2.3	7	4.8 ± 8.7	14	1.4 ± 1.4
	Current non-daily	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.1 ± 0.2	0	0.0 ± 0.0	1	0.0 ± 0.0
	Current daily	3	1.7 ± 2.5	1	0.2 ± 0.3	7	1.0 ± 1.1	10	4.5 ± 3.9	21	1.3 ± 1.0

Table 8.2. Alcohol consumption of participants in Dak Lak

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Ever consume alc.	22	80.8 ± 21.1	34	93.6 ± 7.9	31	84.7 ± 23.3	41	82.5 ± 7.9	128	86.1 ± 9.4
	Consumed last 12ms	21	77.7 ± 20.7	33	90.4 ± 6.9	28	76.6 ± 26.8	37	74.1 ± 12.4	119	81.3 ± 9.8
	Hazardous drinking*	2	6.3 ± 12.3	0	0.0 ± 0.0	4	10.8 ± 8.9	6	12.9 ± 11.1	12	5.9 ± 4.7
	Harmful drinking†	15	58.5 ± 10.2	13	38.6 ± 36.8	5	13.3 ± 9.9	9	17.9 ± 13.4	42	37.1 ± 12.9
	Rural										
	Ever consume alc.	137	91.7 ± 6.0	162	87.8 ± 7.5	169	87.4 ± 7.9	153	83.0 ± 9.5	621	88.7 ± 3.8
	Consumed last 12ms	134	90.1 ± 7.8	152	79.6 ± 8.1	157	81.7 ± 12.4	121	65.5 ± 8.6	564	82.6 ± 4.8
	Hazardous drinking*	20	10.8 ± 6.5	11	6.1 ± 3.5	26	9.9 ± 10.1	5	2.6 ± 3.9	62	8.3 ± 3.4
	Harmful drinking†	60	47.6 ± 6.3	75	36.1 ± 7.0	57	25.8 ± 17.7	34	17.4 ± 11.0	226	36.4 ± 5.1
	Total										
	Ever consume alc.	159	89.5 ± 6.4	196	89.0 ± 6.1	200	86.7 ± 8.2	194	82.8 ± 7.6	749	88.1 ± 3.6
	Consumed last 12ms	155	87.6 ± 7.5	185	81.9 ± 6.5	185	80.5 ± 11.4	158	67.5 ± 7.2	683	82.3 ± 4.3
	Hazardous drinking*	22	9.9 ± 5.7	11	4.8 ± 2.8	30	10.1 ± 8.0	11	4.9 ± 3.9	74	7.8 ± 2.9
	Harmful drinking†	75	49.8 ± 5.4	88	36.7 ± 9.6	62	22.9 ± 13.7	43	17.5 ± 9.0	268	36.6 ± 4.9
Women	*Urban*										
	Ever consume alc.	5	13.7 ± 5.6	2	2.6 ± 5.2	5	11.0 ± 9.1	2	5.9 ± 6.7	14	8.8 ± 3.4
	Consumed last 12ms	5	13.7 ± 5.6	1	1.3 ± 2.6	5	11.0 ± 9.1	2	5.9 ± 6.7	13	8.4 ± 3.1
	Hazardous drinking*	0	0.0 ± 0.0	0	0.0 ± 0.0	1	1.7 ± 3.3	0	0.0 ± 0.0	1	0.4 ± 0.8
	Harmful drinking†	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0	0	0.0 ± 0.0
	Rural										
	Ever consume alc.	24	15.0 ± 10.6	28	24.0 ± 10.5	40	20.3 ± 3.8	24	16.8 ± 5.7	116	19.2 ± 5.2
	Consumed last 12ms	21	11.6 ± 8.3	21	18.3 ± 7.9	34	16.1 ± 2.7	21	14.1 ± 9.1	97	15.0 ± 4.1
	Hazardous drinking*	8	6.9 ± 5.3	3	0.5 ± 0.8	3	1.7 ± 3.0	3	1.8 ± 2.8	17	3.2 ± 2.0
	Harmful drinking†	1	0.1 ± 0.3	0	0.0 ± 0.0	0	0.0 ± 0.0	3	0.5 ± 0.5	4	0.1 ± 0.1
	Total										
	Ever consume alc.	29	14.7 ± 8.4	30	19.3 ± 8.3	45	18.0 ± 3.6	26	14.5 ± 4.7	130	16.9 ± 4.1
	Consumed last 12ms	26	12.1 ± 6.6	22	14.6 ± 6.2	39	14.9 ± 3.0	23	12.4 ± 7.3	110	13.5 ± 3.2
	Hazardous drinking*	8	5.4 ± 4.2	3	0.4 ± 0.6	4	1.7 ± 2.4	3	1.4 ± 2.2	18	2.6 ± 1.6
	Harmful drinking†	1	0.1 ± 0.2	0	0.0 ± 0.0	0	0.0 ± 0.0	3	0.4 ± 0.4	4	0.1 ± 0.1

* Hazardous drinking: ≥4 standard drinks (men), ≥2 standard drinks (women); † Harmful drinking: ≥6 standard drinks (men), ≥4 standard drinks (women).

Table 8.3. Servings of fruit and vegetable in Dak Lak

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5 servings/day	21	80.8 ± 21.1	37	100.0 ± 0.0	35	96.9 ± 6.1	47	95.2 ± 5.4	140	92.4 ± 7.2
	≥ 5 servings/day	3	19.2 ± 21.1	0	0.0 ± 0.0	1	3.1 ± 6.1	2	4.8 ± 5.4	6	7.6 ± 7.2
	Rural										
	< 5 servings/day	151	95.8 ± 5.3	182	96.2 ± 4.0	188	94.4 ± 6.7	175	94.2 ± 7.3	696	95.5 ± 2.8
	≥ 5 servings/day	9	4.2 ± 5.3	4	3.8 ± 4.0	8	5.6 ± 6.7	6	5.8 ± 7.3	27	4.5 ± 2.8
	Total										
	< 5 servings/day	172	92.8 ± 6.0	219	97.0 ± 3.2	223	95.0 ± 5.3	222	94.4 ± 5.8	836	94.8 ± 2.7
	≥ 5 servings/day	12	7.2 ± 6.0	4	3.0 ± 3.2	9	5.0 ± 5.3	8	5.6 ± 5.8	33	5.2 ± 2.7
Women	*Urban*										
	< 5 servings/day	35	82.7 ± 17.4	38	80.7 ± 31.3	45	93.7 ± 12.3	28	81.6 ± 16.0	146	84.7 ± 12.1
	≥ 5 servings/day	5	17.3 ± 17.4	4	19.3 ± 31.3	3	6.3 ± 12.3	6	18.4 ± 16.0	18	15.3 ± 12.1
	Rural										
	< 5 servings/day	178	94.7 ± 9.7	168	92.4 ± 12.9	224	94.5 ± 7.3	171	96.8 ± 4.9	741	94.1 ± 5.6
	≥ 5 servings/day	5	5.3 ± 9.7	10	7.6 ± 12.9	9	5.5 ± 7.3	6	3.2 ± 4.9	30	5.9 ± 5.6
	Total										
	< 5 servings/day	213	92.2 ± 8.5	206	89.8 ± 12.2	269	94.3 ± 6.3	199	93.6 ± 5.1	887	92.1 ± 5.1
	≥ 5 servings/day	10	7.8 ± 8.5	14	10.2 ± 12.2	12	5.7 ± 6.3	12	6.4 ± 5.1	48	7.9 ± 5.1

Table 8.4. Physical activity levels of participants in Dak Lak

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Low*	2	6.3 ± 7.1	5	13.7 ± 3.6	5	14.6 ± 16.8	12	23.3 ± 13.9	24	12.3 ± 5.1
	Moderate†	4	21.9 ± 20.9	6	17.7 ± 14.3	10	27.7 ± 13.3	16	32.7 ± 18.9	36	22.9 ± 9.2
	High‡	19	71.9 ± 20.9	26	68.6 ± 17.8	21	57.7 ± 16.2	22	44.0 ± 5.7	88	64.7 ± 10.0
	Rural										
	Low*	8	8.0 ± 4.7	5	1.9 ± 2.5	12	7.2 ± 7.0	20	12.7 ± 7.7	45	6.2 ± 2.5
	Moderate†	5	4.6 ± 4.7	12	5.6 ± 2.9	22	20.1 ± 3.5	39	19.4 ± 6.6	78	9.6 ± 2.2
	High‡	147	87.4 ± 6.5	169	92.5 ± 4.2	162	72.6 ± 4.4	123	67.9 ± 3.1	601	84.2 ± 2.9
	Total										
	Low*	10	7.6 ± 4.0	10	4.4 ± 2.1	17	9.0 ± 6.7	32	15.1 ± 6.7	69	7.5 ± 2.3
	Moderate†	9	8.1 ± 5.7	18	8.2 ± 3.8	32	21.9 ± 4.1	55	22.4 ± 6.7	114	12.5 ± 2.6
	High‡	166	84.3 ± 6.7	195	87.3 ± 5.0	183	69.1 ± 5.1	145	62.5 ± 2.7	689	80.0 ± 3.1
Women	*Urban*										
	Low*	6	14.7 ± 20.5	8	21.4 ± 25.3	4	7.9 ± 6.7	7	21.2 ± 15.3	25	15.8 ± 10.9
	Moderate†	9	28.3 ± 21.0	13	46.1 ± 36.9	14	28.6 ± 16.6	15	43.8 ± 15.1	51	35.5 ± 14.4
	High‡	25	57.0 ± 23.7	21	32.5 ± 36.9	30	63.5 ± 23.2	12	35.1 ± 23.2	88	48.7 ± 15.5
	Rural										
	Low*	7	5.3 ± 5.8	8	4.2 ± 6.5	17	10.5 ± 4.0	21	17.3 ± 11.7	53	7.3 ± 3.3
	Moderate†	22	12.5 ± 8.5	16	12.5 ± 9.9	42	18.1 ± 5.7	60	37.7 ± 14.8	140	16.3 ± 4.8
	High‡	154	82.2 ± 10.9	154	83.3 ± 10.2	176	71.4 ± 5.7	96	45.1 ± 9.2	580	76.4 ± 5.3
	Total										
	Low*	13	7.3 ± 6.3	16	7.9 ± 7.5	21	9.9 ± 3.4	28	18.1 ± 9.8	78	9.2 ± 3.5
	Moderate†	31	15.8 ± 8.1	29	19.9 ± 11.2	56	20.6 ± 5.9	75	38.9 ± 12.1	191	20.5 ± 4.9
	High‡	179	76.8 ± 10.0	175	72.2 ± 11.4	206	69.5 ± 7.1	108	43.0 ± 8.8	668	70.3 ± 5.4

* Low: < 600 MET-minutes per week; † Moderate: 600-2999 MET-minutes per week; ‡ High: 3000+ MET-minutes per week

Table 8.5. Body mass index of participants in Dak Lak

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<18.5 kg/m2	2	7.1 ± 14.0	2	5.4 ± 6.3	4	10.9 ± 8.1	8	14.5 ± 14.9	16	8.2 ± 5.6
	18.5-22.9 kg/m2	15	67.0 ± 25.5	23	62.4 ± 12.2	23	64.0 ± 18.1	33	67.2 ± 16.2	94	64.7 ± 10.5
	23.0-24.9 kg/m2	3	9.8 ± 11.9	9	24.7 ± 11.6	3	8.4 ± 5.6	5	9.5 ± 8.8	20	14.4 ± 5.7
	25.0-29.9 kg/m2	5	16.1 ± 11.6	3	7.5 ± 5.2	5	14.2 ± 13.6	4	8.7 ± 7.4	17	12.1 ± 5.4
	30+ kg/m2	0	0.0 ± 0.0	0	0.0 ± 0.0	1	2.5 ± 4.9	0	0.0 ± 0.0	1	0.6 ± 1.2
	Rural										
	<18.5 kg/m2	20	16.2 ± 5.3	26	9.2 ± 7.5	28	15.8 ± 11.4	42	24.5 ± 3.7	116	14.5 ± 4.0
	18.5-22.9 kg/m2	119	72.5 ± 4.8	123	67.5 ± 7.4	133	72.3 ± 9.0	103	55.0 ± 5.7	478	69.3 ± 3.6
	23.0-24.9 kg/m2	14	9.9 ± 9.5	28	20.5 ± 5.0	22	6.9 ± 4.9	17	11.6 ± 1.8	81	13.0 ± 4.0
	25.0-29.9 kg/m2	7	1.4 ± 1.1	9	2.8 ± 3.1	12	4.9 ± 4.0	19	8.8 ± 8.3	47	3.3 ± 1.6
	30+ kg/m2	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.1 ± 0.2	1	0.1 ± 0.2	2	0.0 ± 0.1
	Total										
	<18.5 kg/m2	22	14.3 ± 5.1	28	8.4 ± 6.0	32	14.6 ± 8.9	50	22.3 ± 4.4	132	13.1 ± 3.4
	18.5-22.9 kg/m2	134	71.4 ± 6.4	146	66.4 ± 6.3	156	70.3 ± 8.1	136	57.7 ± 5.8	572	68.3 ± 3.6
	23.0-24.9 kg/m2	17	9.9 ± 7.9	37	21.4 ± 4.7	25	7.3 ± 4.0	22	11.1 ± 2.4	101	13.3 ± 3.3
	25.0-29.9 kg/m2	12	4.4 ± 2.5	12	3.8 ± 2.7	17	7.1 ± 4.5	23	8.8 ± 6.6	64	5.2 ± 1.7
	30+ kg/m2	0	0.0 ± 0.0	0	0.0 ± 0.0	2	0.7 ± 1.2	1	0.1 ± 0.2	3	0.2 ± 0.3
Women	*Urban*										
	<18.5 kg/m2	12	32.2 ± 17.2	6	16.7 ± 14.3	2	3.8 ± 4.3	1	2.8 ± 5.4	21	17.5 ± 7.5
	18.5-22.9 kg/m2	21	54.5 ± 10.1	24	50.8 ± 15.6	26	56.9 ± 19.1	18	52.4 ± 18.5	89	53.7 ± 7.8
	23.0-24.9 kg/m2	4	8.4 ± 6.0	6	13.0 ± 12.0	14	28.1 ± 10.3	10	29.9 ± 8.6	34	16.7 ± 5.1
	25.0-29.9 kg/m2	1	2.1 ± 4.1	6	19.4 ± 14.6	6	11.3 ± 8.8	4	11.8 ± 13.4	17	10.8 ± 5.5
	30+ kg/m2	1	2.8 ± 5.4	0	0.0 ± 0.0	0	0.0 ± 0.0	1	3.1 ± 6.1	2	1.2 ± 2.0
	Rural										
	<18.5 kg/m2	42	23.9 ± 8.5	36	19.6 ± 5.5	40	15.0 ± 1.4	39	27.7 ± 7.5	157	21.0 ± 3.6
	18.5-22.9 kg/m2	117	64.1 ± 11.9	106	56.1 ± 11.4	143	62.4 ± 10.4	95	46.5 ± 25.3	461	59.4 ± 6.6
	23.0-24.9 kg/m2	12	7.3 ± 6.9	27	19.3 ± 16.2	34	14.5 ± 9.7	31	15.6 ± 8.6	104	13.5 ± 6.2
	25.0-29.9 kg/m2	11	4.8 ± 3.9	8	4.8 ± 4.2	18	8.1 ± 10.0	12	10.2 ± 10.5	49	6.1 ± 3.1
	30+ kg/m2	0	0.0 ± 0.0	1	0.2 ± 0.4	0	0.0 ± 0.0	0	0.0 ± 0.0	1	0.1 ± 0.1

Total										
<18.5 kg/m2	54	25.7 ± 7.6	42	19.0 ± 5.3	42	12.3 ± 1.5	40	22.4 ± 6.0	178	20.2 ± 3.3
18.5-22.9 kg/m2	138	62.0 ± 9.6	130	54.9 ± 9.6	169	61.1 ± 9.2	113	47.8 ± 20.4	550	58.1 ± 5.4
23.0-24.9 kg/m2	16	7.5 ± 5.6	33	17.9 ± 12.9	48	17.7 ± 7.8	41	18.6 ± 7.0	138	14.3 ± 5.0
25.0-29.9 kg/m2	12	4.2 ± 3.2	14	8.0 ± 4.6	24	8.9 ± 7.9	16	10.6 ± 8.7	66	7.1 ± 2.7
30+ kg/m2	1	0.6 ± 1.2	1	0.2 ± 0.3	0	0.0 ± 0.0	1	0.7 ± 1.3	3	0.3 ± 0.4

Table 8.6. Blood pressure levels of participants in Dak Lak

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	Normotensive	22	81.2 ± 23.5	30	79.8 ± 8.9	19	52.8 ± 3.1	26	51.8 ± 17.9	97	71.1 ± 8.5
	Hypertensive*	3	18.8 ± 23.5	7	20.2 ± 8.9	17	47.2 ± 3.1	24	48.2 ± 17.9	51	28.9 ± 8.5
	Rural										
	Normotensive	135	83.4 ± 8.9	144	79.8 ± 6.1	127	67.6 ± 6.3	94	41.2 ± 11.8	500	75.1 ± 4.2
	Hypertensive*	25	16.6 ± 8.9	42	20.2 ± 6.1	69	32.4 ± 6.3	88	58.8 ± 11.8	224	24.9 ± 4.2
	Total										
	Normotensive	157	82.9 ± 8.6	174	79.8 ± 5.2	146	64.1 ± 4.9	120	43.6 ± 10.0	597	74.2 ± 3.8
	Hypertensive*	28	17.1 ± 8.6	49	20.2 ± 5.2	86	35.9 ± 4.9	112	56.4 ± 10.0	275	25.8 ± 3.8
Women	*Urban*										
	Normotensive	39	97.9 ± 4.1	37	84.1 ± 13.4	40	84.3 ± 7.9	16	46.9 ± 7.6	132	85.3 ± 4.9
	Hypertensive*	1	2.1 ± 4.1	5	15.9 ± 13.4	8	15.7 ± 7.9	18	53.1 ± 7.6	32	14.7 ± 4.9
	Rural										
	Normotensive	173	93.0 ± 6.9	156	91.2 ± 7.4	169	67.9 ± 12.0	107	61.3 ± 10.6	605	83.7 ± 4.5
	Hypertensive*	10	7.0 ± 6.9	22	8.8 ± 7.4	66	32.1 ± 12.0	70	38.7 ± 10.6	168	16.3 ± 4.5
	Total										
	Normotensive	212	94.1 ± 5.5	193	89.6 ± 6.5	209	71.8 ± 9.3	123	58.2 ± 8.5	737	84.0 ± 3.6
	Hypertensive*	11	5.9 ± 5.5	27	10.4 ± 6.5	74	28.2 ± 9.3	88	41.8 ± 8.5	200	16.0 ± 3.6

[*] Systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or using hypertensive medications.

Table 8.7. Fasting blood glucose levels of participants in Dak Lak

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	<5.6 mmol/L	21	81.2 ± 23.5	35	93.7 ± 7.8	29	82.5 ± 11.7	39	79.6 ± 8.0	124	85.5 ± 8.7
	5.6-6.1 mmol/L	1	3.1 ± 6.1	2	6.3 ± 7.8	4	11.9 ± 10.1	5	9.4 ± 6.4	12	6.9 ± 4.2
	6.1+ mmol/L	2	15.6 ± 23.2	0	0.0 ± 0.0	2	5.6 ± 6.4	5	11.0 ± 12.8	9	7.6 ± 8.0
	Rural										
	<5.6 mmol/L	146	94.5 ± 5.3	175	97.2 ± 3.1	173	90.7 ± 2.9	157	85.7 ± 13.9	651	93.8 ± 2.6
	5.6-6.1 mmol/L	8	5.0 ± 5.3	3	0.8 ± 0.9	9	5.6 ± 5.5	12	6.1 ± 5.8	32	3.8 ± 2.3
	6.1+ mmol/L	4	0.6 ± 0.5	4	2.0 ± 3.0	9	3.8 ± 3.4	10	8.2 ± 8.5	27	2.4 ± 1.5
	Total										
	<5.6 mmol/L	167	91.8 ± 6.4	210	96.5 ± 3.0	202	88.7 ± 3.5	196	84.3 ± 11.0	775	92.0 ± 2.8
	5.6-6.1 mmol/L	9	4.6 ± 4.4	5	1.9 ± 1.8	13	7.1 ± 4.8	17	6.9 ± 4.8	44	4.5 ± 2.0
	6.1+ mmol/L	6	3.6 ± 4.7	4	1.6 ± 2.4	11	4.2 ± 3.0	15	8.8 ± 7.2	36	3.5 ± 2.1
Women	*Urban*										
	<5.6 mmol/L	38	95.1 ± 5.6	37	95.4 ± 5.3	39	87.2 ± 8.2	26	81.1 ± 7.7	140	92.0 ± 3.3
	5.6-6.1 mmol/L	1	2.1 ± 4.1	1	1.3 ± 2.6	2	3.8 ± 4.3	2	6.3 ± 7.3	6	2.7 ± 2.1
	6.1+ mmol/L	1	2.8 ± 5.4	2	3.2 ± 3.8	3	9.0 ± 11.6	4	12.6 ± 1.3	10	5.4 ± 3.6
	Rural										
	<5.6 mmol/L	179	99.5 ± 0.5	166	93.5 ± 3.6	214	91.0 ± 2.5	158	88.6 ± 6.4	717	94.6 ± 1.4
	5.6-6.1 mmol/L	2	0.3 ± 0.5	8	4.3 ± 3.8	11	4.5 ± 2.7	8	4.3 ± 6.5	29	2.9 ± 1.5
	6.1+ mmol/L	1	0.1 ± 0.3	2	2.2 ± 3.9	8	4.5 ± 3.1	8	7.0 ± 7.2	19	2.5 ± 1.6
	Total										
	<5.6 mmol/L	217	98.6 ± 1.3	203	93.9 ± 3.0	253	90.1 ± 2.7	184	87.0 ± 5.3	857	94.0 ± 1.3
	5.6-6.1 mmol/L	3	0.7 ± 0.9	9	3.7 ± 3.0	13	4.3 ± 2.3	10	4.8 ± 5.3	35	2.9 ± 1.3
	6.1+ mmol/L	2	0.7 ± 1.2	4	2.4 ± 3.1	11	5.6 ± 3.6	12	8.2 ± 5.7	29	3.1 ± 1.5

Table 8.8. Fasting blood cholesterol levels of participants in Dak Lak

		25–34		35–44		45–54		55–64		Total	
		n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI	n	Mean 95%CI
Men	*Urban*										
	< 5.0 mmol/L	19	73.7 ± 17.0	28	74.6 ± 6.1	22	62.6 ± 11.6	31	61.8 ± 16.9	100	70.2 ± 6.8
	5.0-6.1 mmol/L	3	19.2 ± 21.1	9	25.4 ± 6.1	9	25.6 ± 3.2	14	29.8 ± 11.5	35	23.8 ± 7.4
	6.2+ mmol/L	2	7.1 ± 14.0	0	0.0 ± 0.0	4	11.8 ± 13.4	4	8.5 ± 8.2	10	6.0 ± 5.7
	Rural										
	< 5.0 mmol/L	138	88.3 ± 12.2	141	71.5 ± 8.7	144	70.7 ± 8.6	119	71.2 ± 11.6	542	77.4 ± 5.7
	5.0-6.1 mmol/L	19	11.5 ± 12.2	32	22.4 ± 7.2	41	26.8 ± 8.1	50	26.2 ± 12.6	142	19.7 ± 5.5
	6.2+ mmol/L	1	0.1 ± 0.3	9	6.1 ± 3.4	6	2.5 ± 3.6	8	2.6 ± 2.8	24	2.9 ± 1.4
	Total										
	< 5.0 mmol/L	157	85.4 ± 10.3	169	72.2 ± 6.9	166	68.8 ± 7.1	150	69.1 ± 9.8	642	75.8 ± 4.7
	5.0-6.1 mmol/L	22	13.1 ± 10.6	41	23.0 ± 5.8	50	26.5 ± 6.2	64	27.0 ± 10.1	177	20.6 ± 4.6
	6.2+ mmol/L	3	1.6 ± 2.8	9	4.8 ± 2.7	10	4.7 ± 4.2	12	3.9 ± 2.9	34	3.5 ± 1.7
Women	*Urban*										
	< 5.0 mmol/L	37	93.1 ± 8.2	27	62.7 ± 19.9	22	51.5 ± 27.7	15	45.3 ± 23.8	101	68.7 ± 9.9
	5.0-6.1 mmol/L	3	6.9 ± 8.2	13	37.3 ± 19.9	19	42.0 ± 23.6	14	45.2 ± 26.9	49	28.8 ± 9.4
	6.2+ mmol/L	0	0.0 ± 0.0	0	0.0 ± 0.0	3	6.5 ± 4.6	3	9.5 ± 6.3	6	2.5 ± 1.3
	Rural										
	< 5.0 mmol/L	161	79.5 ± 5.4	146	83.0 ± 14.9	148	58.2 ± 6.3	92	41.4 ± 11.8	547	72.1 ± 5.5
	5.0-6.1 mmol/L	20	20.3 ± 5.4	26	16.4 ± 14.9	71	37.5 ± 4.8	67	43.4 ± 6.6	184	25.2 ± 5.3
	6.2+ mmol/L	1	0.1 ± 0.3	3	0.5 ± 0.6	12	4.3 ± 2.2	15	15.2 ± 8.6	31	2.7 ± 1.0
	Total										
	< 5.0 mmol/L	198	82.4 ± 4.6	173	78.6 ± 12.4	170	56.6 ± 8.2	107	42.2 ± 10.6	648	71.3 ± 4.8
	5.0-6.1 mmol/L	23	17.5 ± 4.6	39	21.0 ± 12.4	90	38.6 ± 6.7	81	43.8 ± 7.7	233	26.0 ± 4.6
	6.2+ mmol/L	1	0.1 ± 0.2	3	0.4 ± 0.5	15	4.9 ± 2.0	18	14.0 ± 7.0	37	2.7 ± 0.9